**Human Reproduction, Vol.31, No.7 pp. 1588–1609, 2016**
Advanced Access publication on May 20, 2016 doi:10.1093/humrep/dew082

human reproduction

**ORIGINAL ARTICLE** ***Reproductive epidemiology***

# International Committee for Monitoring Assisted Reproductive Technologies world report: Assisted Reproductive Technology 2008, 2009 and 2010†

**S. Dyer[1,*], G.M. Chambers[2], J. de Mouzon[3], K.G. Nygren[4], F. Zegers-Hochschild[5], R. Mansour[6], O. Ishihara[7], M. Banker[8], and G.D. Adamson[9]**

[1]Department of Obstetrics & Gynaecology, Groote Schuur Hospital and Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa [2]National Perinatal Epidemiology and Statistics Unit, University of New South Wales, Sydney, Australia [3]Institut National de la Santé et de la Recherche Médicale Service de Gynécologie Obstétrique II et de Médecine de la Reproduction, Groupe Hospitalier Cochin-Saint Vincet de Paul, Paris, France [4]Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden [5]Clinica las Condes and Program of Ethics and Public Policies in Human Reproduction, University Diego Portales, Santiago, Chile [6]Egyptian IVF-ET Center, Cairo, Egypt [7]Department of Obstetrics and Gynaecology, Saitama Medical University, Moroyama, Japan [8]Nova IVI Fertility, Chennai, India [9]Palo Alto Medical Foundation Fertility Physicians of North California, San Jose, CA, USA

*Correspondence address. E-mail: silke.dyer@uct.ac.za

*Submitted on March 10, 2016; resubmitted on March 10, 2016; accepted on March 15, 2016*

**STUDY QUESTION:** What were utilization, outcomes and practices in assisted reproductive technology (ART) globally in 2008, 2009 and 2010?

**SUMMARY ANSWER:** Global utilization and effectiveness remained relatively constant despite marked variations among countries, while the rate of single and frozen embryo transfers (FETs) increased with a concomitant slight reduction in multiple birth rates.

**WHAT IS KNOWN ALREADY:** ART is widely practised in all regions of the world. Monitoring utilization, an approximation of availability and access, as well as effectiveness and safety is an important component of universal access to reproductive health.

**STUDY DESIGN, SIZE, DURATION:** This is a retrospective, cross-sectional survey on utilization, effectiveness and safety of ART procedures performed globally from 2008 to 2010.

**PARTICIPANTS, SETTING, METHODS:** Between 58 and 61 countries submitted data from a total of nearly 2500 ART clinics each year. Aggregate country data were processed and analyzed based on forms and methods developed by the International Committee for Monitoring Assisted Reproductive Technologies (ICMART). Results are presented at country, regional and global level.

**MAIN RESULTS AND THE ROLE OF CHANCE:** For the years 2008, 2009 and 2010, >4 461 309 ART cycles were initiated, resulting in an estimated 1 144 858 babies born. The number of aspirations increased by 6.4% between 2008 and 2010, while FET cycles increased by 27.6%. Globally, ART utilization remained relatively constant at 436 cycles/million in 2008 and 474 cycles/million population in 2010, but with a wide country range of 8–4775 cycles/million population. ICSI remained constant at around 66% of non-donor aspiration cycles. The IVF/ICSI combined delivery rate (DR) per fresh aspiration was 19.8% in 2008; 19.7% in 2009 and 20.0% in 2010, with corresponding DRs for FET of 18.8, 19.7 and 20.7%. In fresh non-donor cycles, single embryo transfer increased from 25.7% in 2008 to 30.0% in 2010, while the average number of embryos transferred fell from 2.1 to 1.9, again with wide regional variation. The rates of twin deliveries following fresh non-donor transfers were, in 2008, 2009 and 2010, 21.8, 20.5 and 20.4%, respectively, with a corresponding triplet rate of 1.3, 1.0 and 1.1%. Fresh IVF and ICSI carried a perinatal mortality rate per 1000 births of 22.8 (2008), 19.2 (2009) and 21.0 (2010), compared with 15.1, 12.8 and 14.6/1000 births following FET in the same periods of observation. The proportion of women aged 40 years or older undergoing non-donor ART increased from 20.8 to 23.2% from 2008 to 2010.

†This manuscript has not been externally peer reviewed.

© The Author 2016. Published by Oxford University Press on behalf of the European Society of Human Reproduction and Embryology. All rights reserved.
For Permissions, please email: journals.permissions@oup.com

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**LIMITATIONS, REASON FOR CAUTION:** The data presented are reliant on the quality and completeness of data submitted by individual countries. This report covers approximately two-thirds of the world ART activity.

**WIDER IMPLICATIONS OF FINDINGS:** The ICMART World Reports provide the most comprehensive global statistical census and review of ART utilization, effectiveness, safety and quality. While ART treatment continues to increase globally, the wide disparities in access to treatment and embryo transfer practices warrant attention by clinicians and policy makers.

**STUDY FUNDING/COMPETING INTEREST(S):** The authors declare no conflict of interest and no specific support from any organizations in relation to this manuscript. ICMART acknowledges financial support from the following organizations: American Society for Reproductive Medicine; European Society for Human Reproduction and Embryology; Fertility Society of Australia; Japan Society for Reproductive Medicine; Japan Society of Fertilization and Implantation; Red Latinoamericana de Reproduccion Asistida; Society for Assisted Reproductive Technology; Government of Canada (Research grant), Ferring Pharmaceuticals (Grant unrelated to World Reports).

**TRIAL REGISTRATION:** not applicable.

**Key words:** assisted reproductive technology / registry / IVF/ICSI outcome / multiple births / frozen embryo transfer / ICMART

# Introduction

This is the fifteenth world report on assisted reproductive technology (ART), and the tenth produced by the International Committee for Monitoring Assisted Reproductive Technologies (ICMART). ICMART, previously called the International Working Group of Registers in Assisted Reproduction, has generated annual world reports since 1989 (Lancaster, 1996). For the first time, the current report presents triennium data (2008–2009–2010) on the global utilization, effectiveness and safety of ART, the resultant pregnancy and neonatal outcomes as well as information on international ART practices.

# Material and Methods

The process of data collection and analysis has been previously described in detail (Zegers-Hochschild *et al.*, 2014). Briefly, data for ART treatment conducted during 2008, 2009 and 2010 were collected from regional or national ART registries or directly from individual clinics in a few countries where no registry exists. Standardized forms, available in the ICMART Tool Box for ART (www.icmartivf.org), were used to collect information on number of ART clinics, and on procedure and outcome-related information pertaining to IVF, ICSI, oocyte donation and frozen embryo transfer (FET). Information on PGD and intrauterine insemination (IUI, with both husband/partner and donor sperm) was also collected. All data were aggregated country data and did not include any individual patient information. Terminology was based on the 2009 ICMART-World Health Organization (WHO) ART Glossary (Zegers-Hochschild *et al.*, 2009). Collected data were transferred by ICMART to the Clinical Research Center of Uppsala University, Sweden, for further processing and analysis. Data were checked for consistency, and a statistical report plus tables and graphs was generated for each year using SAS software (version 9.4) and R (version 3.1.1). Data are presented by country, region [to address political sensitivities, the Middle East region was separated for the purpose of data presentation into 'Middle East' and 'Middle East (Israel)] and year, as well as in a few instances as aggregated data for the triennium. Stratification by woman's age or number of embryos transferred is also provided.

No Institutional Review Board approval was requested by ICMART since relevant approvals were obtained at country level.

# Results

Key findings are summarized in Tables I and II and Fig. 1. The suffix 'a' marks a table or figure as capturing data for the year 2008 while 'b' and 'c' refer to data from 2009 and 2010, respectively. Additional results are available online (Supplementary data, Tables SI–SXIV and Figs S1–S5).

## Utilization

Data were submitted by 58 countries in 2008, 61 countries in 2009 and 60 countries in 2010, compared with 54 countries in 2007 (Ishihara *et al.*, 2015). While this is an overall increase, sub-analysis demonstrated that in the triennium period five countries stopped reporting, four countries reported inconsistently and 14 countries started reporting. The number of clinics participating and the global participation rate, calculated as all participating clinics over total number of clinics, was 2428 and 72.9% in 2008; 2384 and 71.4% in 2009; and 2473 and 71.6% in 2010. Participation rates >80% were recorded in 27 (2008) and 31 (2009; 2010) countries and two regions (Australia/New Zealand; Europe), while 26 (2008), 27(2009) and 28 (2010) countries and one region (Australia/New Zealand) reached participation rates of >95% (Supplementary data, Table SIa–c). The highest concentration of participating clinics was found in Europe (41.8% of all participating clinics; calculated as the sum of participating clinics in the region over the sum of all participating clinics in the triennium), followed by Asia (33.0%) and North America (16.2%). At a country level, Japan accounted for 23.8% of all participating clinics in the triennium followed by the USA (15.1%). Clinics performing <100 cycles annually predominated in sub-Saharan Africa and Asia, while in Israel and Australia/New Zealand over 40% of clinics performed >1000 cycles annually (Supplementary data, Table SIa–c).

During the triennium, based on both reported and estimated numbers for the countries providing data for this report, a total of >4 461 309 ART cycles were initiated: 1 364 943 in 2008; 1 452 910 in 2009; and 1 643 456 in 2010 (Tables Ia–Ic). The annual increase to each preceding year was, in chronological order, 9.0, 6.4 and 13.1%. ART utilization, reflected in the number of initiated cycles per million population, remained relatively constant in the triennium, being 450 in 2008, 419 in 2009 and 474 in 2010. As expected the range was wide, from 8 (Dominican Republic, 2010) to 4775 cycles per million inhabitants (Israel, 2010). In 2010, availability was highest in Israel (4775), followed by Australia/New Zealand (2337); and lowest in Latin America (152) and sub-Saharan Africa (87). The number of reported aspirations increased by 6.4% from 2008 to 2010: from 734 283 in 2008 to 781 626 in 2010 (Tables Ia–Ic). Japan conducted 18.2% of all aspirations in the triennium, followed by the USA (10.7%) and France (7.2%). Reported non-donor

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ia** Reported data and ICMART estimations (bold) for year 2008.

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| India | **15 687** | NA | NA | NA | **29.0** | **32.8** | 33.5 | **90 870** | **79** | 6484 | **26 738** |
| Japan | 125 727 | 11.0 | 6.9 | 16.3 | 7.4 | 17.3 | 21.5 | **19 1115** | **1501** | 21 794 | **22 011** |
| South Korea | 20 901 | 30.2 | **20.8** | **26.6** | NA | NA | 13.1 | **51 353** | **1043** | **7216** | **13 322** |
| Australia[a] | 30 740 | 25.0 | 19.5 | 29.8 | 21.2 | 32.6 | 19.8 | 55 269 | 2683 | 10 531 | 10 531 |
| New Zealand[a] | 2667 | 33.2 | 25.9 | 39.8 | 28.0 | 42.7 | 25.3 | 4820 | 1155 | 1199 | 1199 |
| Albania | 143 | 41.3 | 30.1 | 30.1 | 42.7 | 42.7 | 0.0 | **652** | **180** | 68 | **272** |
| Austria[a] | 5320 | 33.4 | **23.1** | **25.0** | NA | NA | NA | 6576 | 801 | **1724** | **1724** |
| Belgium | 16 840 | 27.3 | 19.2 | 25.5 | 21.5 | 29.4 | 20.2 | 28 576 | 2747 | 5084 | 5084 |
| Bosnia and Herzegovina[a] | 167 | 33.5 | 18.0 | 18.0 | 19.2 | 19.2 | NA | **900** | **196** | 32 | **160** |
| Bulgaria | 2891 | 34.9 | 29.2 | 30.0 | 37.9 | 38.7 | 15.2 | **5603** | **771** | 1158 | **1969** |
| Czech Republic[a] | 11 788 | 32.4 | **22.3** | **26.1** | NA | NA | NA | 17 569 | 1719 | **3984** | **3984** |
| Denmark | 10 209 | 26.0 | 21.6 | 24.8 | 25.2 | 28.9 | 17.9 | 13 396 | 2442 | 3024 | 3024 |
| Estonia | 1620 | 35.2 | 28.3 | 32.2 | 35.2 | 40.1 | 18.6 | 2256 | 1725 | 650 | 650 |
| Finland | 4871 | 27.1 | 20.2 | 31.0 | 22.0 | 34.1 | 17.9 | 8877 | 1693 | 1772 | 1772 |
| France | 51 534 | 25.0 | 19.8 | 23.5 | 23.3 | 27.4 | 13.4 | **77 452** | **1209** | 14 369 | **15 087** |
| Germany | 46 431 | 27.1 | 14.5 | 17.9 | 16.8 | 22.3 | 15.8 | 69 487 | 844 | 10 354 | 10 354 |
| Greece | 1981 | 22.1 | 16.8 | 18.1 | 20.7 | 22.2 | 11.0 | **20 408** | **1903** | 457 | **3808** |
| Hungary | 2431 | 36.1 | 29.1 | 33.8 | 35.8 | 41.4 | 25.8 | **5458** | **550** | 1020 | **1749** |
| Iceland | 411 | 21.9 | 19.7 | 32.8 | 21.9 | 37.7 | 29.5 | **720** | **2366** | 178 | 178 |
| Ireland | 2428 | 29.9 | 25.5 | 29.2 | 31.3 | 35.6 | 18.5 | **4882** | **1175** | 873 | **1222** |
| Italy | 39 434 | 22.4 | 15.0 | 15.2 | 19.0 | 19.3 | 19.1 | 44 545 | 766 | 7592 | 7592 |
| Kazakhstan | 1005 | 35.2 | 28.4 | 33.4 | 37.2 | 43.8 | 21.3 | **9114** | **594** | 513 | **3078** |
| Latvia | 176 | 39.2 | **27.3** | **33.5** | NA | NA | NA | **1348** | **600** | **77** | **308** |
| Lithuania | 421 | 27.6 | 4.0 | 4.5 | 5.7 | 6.2 | 4.8 | **1000** | **280** | 26 | **52** |
| Macedonia | 1424 | 33.8 | 27.8 | 28.2 | 38.5 | 38.9 | 20.0 | 1536 | 745 | 554 | 554 |
| Moldova | 582 | 44.3 | 37.6 | 37.6 | 47.4 | 47.4 | NA | 613 | 142 | 276 | 276 |
| Montenegro | 324 | 36.4 | 32.7 | 34.0 | 42.9 | 44.8 | 19.4 | 370 | 546 | 145 | 145 |
| Netherlands | 15 710 | 28.2 | 21.0 | 25.1 | 24.0 | 28.6 | 17.0 | 21 509 | 1292 | 4487 | 4487 |
| Norway | 5685 | 28.6 | 24.5 | 30.8 | 27.5 | 34.4 | 16.7 | 8525 | 1836 | 1958 | 1958 |
| Poland | 6589 | 38.7 | **26.7** | **33.0** | 32.1 | 43.2 | 25.1 | NA | NA | 3025 | NA |
| Portugal | 4197 | 30.1 | 23.3 | 25.6 | 28.1 | 30.9 | 21.0 | 5523 | 517 | 1385 | 1385 |



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Romania | 954 | 29.9 | 4.8 | 5.5 | NA | NA | NA | **3324** | **149** | 67 | **201** |
| Russia | 24 466 | 33.3 | 22.6 | 24.9 | 28.1 | 31.4 | 24.9 | **41 445** | **295** | 8422 | **11 363** |
| Serbia | 1503 | 28.5 | 22.3 | 22.3 | 25.7 | 25.7 | NA | **3148** | **310** | 390 | **780** |
| Slovenia | 2862 | 29.7 | 23.8 | 27.7 | 28.5 | 32.9 | 18.4 | 3688 | 1837 | 950 | 950 |
| Spain | 23 522 | 34.3 | 19.8 | 23.5 | 24.9 | 30.7 | 23.6 | **76 529** | **1890** | 9089 | **18 380** |
| Sweden | 10 326 | 29.2 | 23.1 | 31.4 | 24.8 | 33.6 | 21.5 | 16 055 | 1775 | 3535 | 3535 |
| Switzerland | 4519 | 26.1 | 18.9 | 30.0 | 22.9 | 36.0 | 17.9 | **8816** | **1163** | 1625 | **1690** |
| Turkey | 43 928 | 36.2 | NA | NA | 51.8 | 51.8 | NA | **47 432** | **660** | 22 764 | 22 764 |
| Ukraine | 5608 | 35.9 | 28.5 | 32.6 | 36.5 | 41.7 | 28.6 | **10 985** | **239** | 2620 | **3930** |
| UK | 36 556 | 31.3 | 27.6 | 32.0 | 34.5 | 39.8 | 23.1 | 50 371 | 827 | 15 270 | 15 270 |
| Argentina | 5412 | 25.3 | 20.3 | 23.5 | 24.7 | 28.4 | 18.4 | **18 303** | **450** | 2256 | **4615** |
| Bolivia | 48 | 10.4 | 10.4 | 10.4 | 14.6 | 14.6 | 0.0 | **246** | **27** | 7 | **21** |
| Brazil | 11 434 | 33.2 | 26.1 | 29.3 | 35.8 | 39.7 | 21.4 | **28 505** | **149** | 5154 | **9042** |
| Chile | 1258 | 35.9 | 30.4 | 34.1 | 38.5 | 42.7 | 18.3 | **2061** | **125** | 592 | **666** |
| Colombia | 988 | 31.6 | 21.3 | 22.6 | 26.7 | 28.7 | 23.0 | **2016** | **45** | 422 | **591** |
| Ecuador | 262 | 34.4 | 7.3 | 8.4 | 10.3 | 11.5 | 23.1 | **831** | **60** | 110 | **193** |
| Guatemala | 56 | 37.5 | 21.4 | 21.4 | 28.6 | 28.6 | 0.0 | **156** | **12** | 26 | **52** |
| Mexico | 2766 | 31.7 | 26.0 | 28.5 | 32.8 | 35.8 | 22.0 | **13 836** | **126** | 1371 | **4640** |
| Peru | 805 | 27.3 | 22.0 | 22.7 | 27.3 | 28.1 | 7.0 | **4549** | **156** | 591 | **1576** |
| Uruguay | 219 | 29.2 | 25.6 | 27.4 | 33.3 | 35.6 | 12.8 | **501** | **144** | 88 | **132** |
| Venezuela | 729 | 33.7 | 25.7 | 29.1 | 32.2 | 36.4 | 29.1 | **1728** | **65** | 394 | **525** |
| Egypt | 10 311 | 36.8 | NA | NA | 42.7 | 45.5 | 23.4 | **57 024** | **698** | 4699 | **21 146** |
| Lebanon | 798 | 30.5 | NA | NA | 25.1 | 25.2 | 12.5 | NA | NA | 260 | NA |
| Saudi Arabia | 346 | 39.3 | 33.8 | 39.0 | 35.3 | NA | 17.3 | NA | NA | **175** | NA |
| Israel[a] | **22 775** | **25.2** | **17.4** | **22.4** | NA | NA | NA | 29 196 | 4105 | **6607** | **6607** |
| Canada | 9401 | 39.1 | 31.0 | 39.1 | 40.2 | 50.4 | 27.1 | 14 592 | 439 | 5090 | 5090 |
| USA | 82 097 | 42.7 | 34.3 | 42.7 | 45.7 | 56.2 | 38.5 | **17 9284** | **590** | 59 912 | **78 832** |
| **Region** | **Fresh IVF and ICSI** | | | | | | **FET** | | | | |
| | **Aspirations[a]** | **PR/ Asp[b] (%)** | **DR/ Asp[c] (%)** | **DR/Asp[d] Cumul. (%)** | **Babies[e] /Asp fresh (%)** | **Babies[e] /Asp Cumul. (%)** | **Babies[e] /FET (%)** | **Estimated[f] or reported overall total number of cycles** | **Availability[g] cycles/million** | **Total[h,j] babies reported from participating clinics** | **Total[i,j] babies estimated from all clinics** |
| Asia | 162 315 | 13.7 | 8.9 | 17.8 | 9.8 | 19.0 | 21.2 | 333 338 | 252 | 35 494 | 62 071 |
| Australia and New Zealand | 33 407 | 25.7 | 20.0 | 30.6 | 21.8 | 33.4 | 20.3 | 60 089 | 2425 | 11 730 | 11 730 |
| Europe | 38 8856 | 29.5 | 20.6 | 24.3 | 27.9 | 32.1 | 18.6 | >618 688 | 817 | 129 517 | >149 735 |
| Latin America | 23 977 | 31.3 | 24.4 | 27.4 | 31.9 | 35.5 | 20.2 | 72 732 | 146 | 11 011 | 22 053 |

*Continued*



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ia** *Continued*

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| Middle East | 11 455 | 36.4 | 33.8 | 39.0 | 41.2 | 44.1 | 23.1 | >57 024 | 698 | 5134 | >21 146 |
| Middle East (Israel) | 22 775 | 25.2 | 17.4 | 22.4 | NA | NA | NA | 29 196 | 4105 | 6607 | 6607 |
| North America | 91 498 | 42.3 | 33.9 | 42.3 | 45.1 | 55.6 | 36.9 | 19 3876 | 575 | 65 002 | 83 922 |
| Total | 734 283 | 27.8 | 19.8 | 25.7 | 26.5 | 32.9 | 22.1 | >1364 943 | 450 | 264 495 | >357 264 |

ICMART, International Committee for Monitoring Assisted Reproductive Technologies; FET, frozen embryo transfer; PR, pregnancy rate; DR, delivery rate; Asp, aspiration; NA, not available.
Cumul., Cumulative rate per aspiration, computed by adding the FET deliveries and babies to those obtained after fresh cycle, the sum being divided by the number of aspirations.
The total numbers and numbers by region were calculated only from the countries with complete data (e.g. both number of pregnancies and number of oocyte aspirations).
[a–j]Imputed/estimated data printed in bold.
[a]Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.
[b]Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.
[c]Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.
[d]Imputed by calculating the mean percentage of deliveries per pregnancy.
[e]In countries where the sum of singleton, twins and triplets were less than the total number of deliveries, the number of unknown babies and lost to follow-up deliveries were estimated by applying distribution of observed deliveries in which this was known.
[f]Initiated cycles overall countries estimation. Step 1: Reported cycles for countries reporting them, or estimation by applying their cancellation rate to the aspiration numbers for the countries not reporting them. Step 2: Total of Step 1 if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[g]Total estimated number of cycles in the country divided by its population in 2008 (CIA World Fact Book).
[h]Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.
[i]Total babies reported if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[j]Total babies also includes PGD and oocyte donation (OD).



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ib** Reported data and ICMART estimations (bold) for year 2009.

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| India[a] | 19 626 | 40.0 | **29.1** | **32.6** | 43.5 | 48.7 | 33.1 | **92 616** | **79** | 11 426 | **38 371** |
| Indonesia | **764** | **33.2** | NA | NA | NA | NA | NA | **1902** | **8** | NA | NA |
| Japan | 134 473 | 10.5 | 7.3 | 19.2 | 8.9 | 21.3 | 23.5 | 211 942 | 1668 | 28 622 | 28 622 |
| South Korea | 20 869 | 29.0 | **21.2** | **27.8** | NA | NA | 14.6 | **63 670** | NA | **7202** | **16 605** |
| Australia[a] | 35 875 | 25.1 | 19.4 | 29.4 | 21.2 | 32.2 | 20.1 | 63 191 | 2972 | 12 057 | 12 057 |
| New Zealand[a] | 2895 | 34.7 | 26.8 | 38.8 | 28.9 | 41.8 | 24.0 | 5118 | 1215 | 1279 | 1279 |
| Austria | 5766 | 31.8 | **23.2** | **24.9** | NA | NA | NA | **6665** | **812** | **1780** | **1780** |
| Belgium | 17 802 | 26.1 | 18.4 | 24.1 | 20.6 | 27.6 | 19.1 | **28 872** | **2772** | 5123 | 5123 |
| Bulgaria | 1579 | 30.1 | 26.3 | 27.2 | 31.0 | 32.2 | 18.0 | **4369** | **606** | 548 | **1331** |
| Croatia | 3099 | 22.5 | 18.9 | 20.5 | 23.4 | 23.4 | NA | 4080 | 909 | 726 | 726 |
| Cyprus | 1202 | 41.3 | 30.4 | 30.4 | NA | NA | NA | 1421 | 1784 | NA | NA |
| Czech Republic[a] | 11 706 | 26.9 | **19.6** | **24.7** | NA | NA | NA | 19 506 | 1910 | **3590** | **3590** |
| Denmark | 11 145 | 26.5 | 18.4 | 21.4 | 21.4 | 25.5 | 17.6 | 14 992 | 2726 | 2923 | 2923 |
| Finland | 4424 | 29.5 | 22.6 | 35.8 | 24.4 | 38.9 | 19.7 | 8814 | 1679 | 1719 | 1719 |
| France | 56 234 | 25.5 | 20.1 | 24.1 | 23.4 | 27.9 | 14.6 | **78 667** | **1228** | 15 825 | 15 825 |
| Germany | 49 436 | 26.8 | 13.6 | 16.9 | 16.5 | 22.2 | 16.3 | 68 041 | 826 | 10 961 | 10 961 |
| Greece | 1903 | 26.2 | 11.5 | 12.7 | 15.2 | 16.8 | 14.8 | NA | NA | 327 | **4088** |
| Hungary | 6215 | 30.3 | **22.1** | **23.7** | NA | NA | NA | 7111 | 718 | **1833** | **1833** |
| Iceland | 463 | 23.1 | 19.2 | 28.5 | 22.0 | 32.2 | 22.7 | **806** | **2628** | 169 | 169 |
| Ireland | 2736 | 28.2 | 22.9 | 27.1 | 28.3 | 32.8 | 18.7 | **4740** | **1128** | 898 | **1048** |
| Italy | 43 243 | 23.0 | 14.8 | 15.1 | 18.7 | 19.0 | 15.9 | 48 930 | 842 | 8226 | 8226 |
| Kazakhstan | 941 | 34.1 | 25.1 | 30.8 | 35.9 | 42.7 | 23.8 | **7125** | **463** | 513 | **2565** |
| Latvia | 491 | 35.8 | **26.1** | **34.6** | NA | NA | NA | **1015** | **455** | **211** | **281** |
| Lithuania | 115 | 39.1 | 26.1 | 27.8 | 38.3 | 40.0 | 16.7 | **556** | **156** | 46 | **184** |
| Macedonia | 1858 | 42.2 | 31.4 | 32.1 | 42.7 | 43.5 | 25.4 | 2062 | 998 | 825 | 825 |
| Moldova | 596 | 40.3 | 34.9 | 34.9 | 43.3 | 43.3 | NA | 625 | 145 | 258 | 258 |

*Continued*



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ib** *Continued*

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| Montenegro | 430 | 35.1 | 31.9 | 33.3 | 39.3 | 40.9 | 23.3 | 482 | 717 | 176 | 176 |
| Netherlands | 15 553 | 30.3 | 22.5 | 28.2 | 25.1 | 31.3 | 18.1 | 22 406 | 1340 | 4862 | 4862 |
| Norway | 6179 | 28.0 | 23.5 | 29.2 | 26.2 | 32.4 | 19.2 | 8529 | 1830 | 2005 | 2005 |
| Poland | 7741 | 36.9 | **26.9** | **33.1** | 28.5 | 39.4 | 25.9 | **14 936** | **388** | 3190 | **3956** |
| Portugal | 4423 | 30.6 | 22.7 | 25.5 | 28.2 | 31.5 | 22.2 | 6023 | 562 | 1522 | 1522 |
| Romania | 912 | 27.6 | 5.0 | 5.2 | 6.9 | 9.3 | 21.8 | **1578** | **71** | 87 | **131** |
| Russia | 31 661 | 34.0 | 19.9 | 22.0 | 25.4 | 29.4 | 24.8 | **57 056** | **407** | 10 172 | **14 213** |
| Serbia | 1180 | 34.7 | 27.9 | 27.9 | 40.1 | 40.1 | NA | **1643** | **223** | 473 | **631** |
| Slovenia | 2806 | 33.1 | 26.2 | 29.7 | 30.8 | 34.7 | 15.9 | 3669 | 1829 | 974 | 974 |
| Spain | 30 311 | 34.1 | 19.3 | 22.8 | 23.1 | 28.8 | 25.2 | **81 808** | **2019** | 12 351 | **18 810** |
| Sweden | 10 824 | 30.3 | 23.8 | 32.7 | 25.3 | 34.7 | 23.4 | 16 895 | 1865 | 3857 | 3857 |
| Switzerland | 4852 | 24.9 | 18.6 | 29.6 | 22.3 | 34.7 | 16.9 | **9463** | **1244** | 1686 | **1753** |
| Ukraine | 5768 | 36.0 | 28.9 | 33.7 | 37.0 | 43.5 | 30.4 | **11 308** | **247** | 2889 | **4045** |
| UK | 39 850 | 31.1 | 27.0 | 31.2 | 33.2 | 38.4 | 23.6 | 54 069 | 885 | 16 106 | 16 106 |
| Argentina | 5781 | 26.4 | 20.1 | 24.1 | 23.8 | 28.5 | 22.0 | **22 282** | NA | 2567 | **5717** |
| Bolivia | 69 | 11.6 | 11.6 | 14.5 | 11.6 | 15.9 | 33.3 | **306** | **31** | 14 | **42** |
| Brazil | 11 320 | 31.9 | 25.6 | 29.8 | 32.8 | 37.9 | 24.8 | **30 363** | **153** | 4897 | **9069** |
| Chile | 1273 | 30.2 | 24.5 | 29.1 | 31.3 | 37.2 | 27.5 | **2521** | **152** | 574 | **738** |
| Colombia | 972 | 28.3 | 22.8 | 26.2 | 29.9 | 34.0 | 30.2 | **1686** | **37** | 486 | **535** |
| Ecuador | 232 | 28.9 | 22.8 | 29.3 | 25.4 | 33.2 | 35.3 | **866** | **59** | 122 | **244** |
| Guatemala | 82 | 39.0 | 29.3 | 31.7 | 32.9 | 36.6 | 50.0 | **196** | **15** | 36 | **72** |
| Mexico | 2973 | 31.8 | 25.9 | 29.3 | 34.1 | 38.2 | 28.3 | **16 819** | **151** | 1639 | **5769** |
| Peru | 873 | 26.9 | 20.3 | 21.9 | 25.5 | 27.3 | 17.0 | **4947** | **167** | 563 | **1501** |
| Uruguay | 276 | 33.3 | 25.7 | 30.4 | 29.3 | 34.1 | 19.7 | **632** | **181** | 120 | **180** |
| Venezuela | 1079 | 29.7 | 23.6 | 26.3 | 28.6 | 31.4 | 22.9 | **2051** | **76** | 463 | **540** |
| Egypt | 7824 | 34.1 | 29.2 | 32.0 | 37.1 | 40.3 | 21.2 | **73 320** | **882** | 3157 | **23 678** |
| Lebanon | 847 | 25.9 | 17.0 | 17.1 | 24.8 | 24.8 | NA | **11 780** | **2932** | 265 | **2650** |
| Palestinian Territory | 174 | 33.9 | 31.6 | 31.6 | 54.6 | 54.6 | NA | **1770** | **441** | 95 | **950** |



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tunisia | 2797 | 34.1 | 28.5 | 33.1 | 33.7 | 39.1 | 26.4 | **13 556** | **1293** | 1094 | **4376** |
| Israel[a] | **25 687** | **23.7** | **17.3** | **21.9** | NA | NA | NA | 31 978 | 4421 | **7005** | **7005** |
| Canada | 9955 | 40.5 | 32.4 | 41.0 | 41.9 | 52.6 | 26.9 | 15 926 | NA | 5687 | 5687 |
| USA | 81 358 | 43.0 | 34.7 | 43.7 | 45.8 | 57.0 | 39.0 | **178 572** | **581** | 60 241 | **79 446** |
| Cameroon | 107 | 23.4 | 12.1 | 13.1 | 14.0 | 15.0 | 20.0 | **288** | **15** | 16 | **32** |
| South Africa | 3305 | 29.5 | **21.5** | **21.5** | NA | NA | NA | **6172** | **126** | **882** | **1544** |
| Togo | 109 | 19.3 | 13.8 | 13.8 | 14.7 | 14.7 | 0.0 | 178 | 30 | 25 | 25 |
| Asia | 175 732 | 16.1 | 11.4 | 21.7 | 13.3 | 24.8 | 23.2 | 370 130 | 200 | >47 250 | >83 598 |
| Australia and New Zealand | 38 770 | 25.8 | 19.9 | 30.1 | 21.8 | 32.9 | 20.4 | 68 309 | 2681 | 13 336 | 13 336 |
| Europe | 383 444 | 28.8 | 20.0 | 23.7 | 23.8 | 28.7 | 19.4 | >598 262 | 848 | >116 851 | >136 496 |
| Latin America | 24 930 | 30.4 | 23.9 | 27.8 | 30.1 | 34.7 | 24.6 | 82 669 | 129 | 11 481 | 24 407 |
| Middle East | 11 642 | 33.5 | 28.2 | 31.2 | 35.7 | 39.1 | 22.9 | 100 426 | 988 | 4611 | 31 654 |
| Middle East (Israel) | 25 687 | 23.7 | 17.3 | 21.9 | NA | NA | NA | 31 978 | 4421 | 7005 | 7005 |
| North America | 91 313 | 42.7 | 34.4 | 43.4 | 45.4 | 56.5 | 37.3 | 194 498 | 581 | 65 928 | 85 133 |
| Sub-Saharan Africa | 3521 | 29.0 | 21.0 | 21.0 | 14.4 | 14.8 | 12.5 | 6638 | 90 | 923 | 1601 |
| Total | 755 039 | 27.3 | 19.9 | 26.1 | 24.6 | 32.2 | 23.1 | >1 452 910 | 419 | >267 385 | >383 230 |

ICMART, International Committee for Monitoring Assisted Reproductive Technologies; FET, frozen embryo transfer; PR, pregnancy rate; DR, delivery rate; Asp, aspiration; NA, not available.
Cumul., Cumulative rate per aspiration, computed by adding the FET deliveries and babies to those obtained after fresh cycle, the sum being divided by the number of aspirations.
The total numbers and numbers by region were calculated only from the countries with complete data (e.g. both number of pregnancies and number of oocyte aspirations).
[a–j]Imputed/estimated data printed in bold.
[a]Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.
[b]Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.
[c]Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.
[d]Imputed by calculating the mean percentage of deliveries per pregnancy.
[e]In countries where the sum of singleton, twins and triplets were less than the total number of deliveries, the number of unknown babies and lost to follow-up deliveries were estimated by applying distribution of observed deliveries in which this was known.
[f]Initiated cycles overall countries estimation. Step 1: Reported cycles for countries reporting them, or estimation by applying their cancellation rate to the aspiration numbers for the countries not reporting them. Step 2: Total of Step 1 if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[g]Total estimated number of cycles in the country divided by its population in 2009 (CIA World Fact Book).
[h]Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.
[i]Total babies reported if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[j]Total babies also includes PGD and oocyte donation (OD).



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ic** Reported data and ICMART estimations (bold) for year 2010.

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| India | **21 779** | **30.6** | NA | NA | **34.0** | **40.0** | 44.5 | **118 670** | **103** | 10 410 | **41 092** |
| Indonesia[a] | 1814 | 37.2 | **27.8** | **27.8** | NA | NA | NA | **3732** | **16** | **618** | **1180** |
| Japan | 153 729 | 9.3 | 6.2 | 18.1 | 6.5 | 19.9 | 25.3 | **242 833** | **1911** | 30 556 | **30 764** |
| South Korea | 23 202 | 29.7 | **22.2** | **29.8** | NA | NA | 18.5 | **68 805** | NA | 73 | **155** |
| Taiwan | **8162** | **47.9** | **35.8** | **35.8** | NA | NA | NA | 12 428 | 541 | NA | NA |
| Australia[a] | 30 335 | 26.0 | 19.9 | 31.6 | 21.6 | 34.5 | 21.9 | 54 465 | 2562 | 10 908 | 10 908 |
| New Zealand[a] | 2850 | 33.6 | 26.2 | 39.3 | 28.6 | 42.2 | 25.1 | 5069 | 1203 | 1280 | 1280 |
| Austria | 5782 | 34.5 | **25.8** | **27.7** | 27.0 | NA | NA | 6781 | 826 | **1967** | **1967** |
| Belgium | 17 657 | 26.0 | 18.3 | 24.5 | 21.4 | 28.4 | 17.2 | 31 162 | 2992 | 5376 | 5376 |
| Bulgaria | 4626 | 28.9 | 22.9 | 23.9 | 32.1 | 33.3 | 23.5 | **15 120** | **2099** | 1595 | **4785** |
| Czech Republic[a] | 11 985 | 50.2 | 24.8 | 31.1 | NA | NA | NA | 20 102 | 1968 | **5359** | **5359** |
| Denmark | 11 721 | 25.4 | 22.7 | 26.9 | 26.3 | 31.1 | 20.5 | 15 729 | 2860 | 3724 | 3724 |
| Finland | 4663 | 29.6 | 23.7 | 36.3 | 26.5 | 40.2 | 19.4 | 8698 | 1657 | 1873 | 1873 |
| France | 56 492 | 26.2 | 20.5 | 24.8 | 24.2 | 29.0 | 14.5 | **85 122** | **1329** | 16 534 | **17 011** |
| Germany | 44 695 | 27.7 | 19.1 | 23.9 | 27.0 | 32.6 | 14.9 | **75 701** | **919** | 14 568 | **15 846** |
| Greece | 2413 | 31.9 | 24.9 | 29.0 | 33.1 | 38.7 | 30.8 | **20 472** | **1907** | 1116 | **6200** |
| Hungary | 5074 | 30.8 | **23.0** | **24.3** | NA | NA | NA | 5579 | 563 | **1514** | **1514** |
| Iceland | 502 | 29.1 | 24.3 | 34.1 | 27.7 | 38.4 | 27.0 | **845** | **2755** | 216 | 216 |
| Ireland | 2656 | 31.9 | 25.8 | 30.4 | 31.1 | 36.3 | 20.3 | **4758** | **1132** | 971 | **1133** |
| Italy | 47 449 | 23.1 | 15.8 | 16.7 | 19.6 | 20.7 | 15.0 | 56 419 | 971 | 9836 | 9836 |
| Kazakhstan | 1630 | 34.4 | 25.1 | 28.2 | 31.5 | 36.0 | 26.7 | **7460** | **484** | 718 | **2393** |
| Lithuania | 110 | 30.0 | **22.7** | **27.3** | NA | NA | NA | **524** | **147** | **37** | **148** |
| Macedonia | 1292 | 42.0 | 33.5 | 34.1 | 45.5 | 46.2 | 19.6 | 1484 | 718 | 611 | 611 |
| Moldova | 600 | 39.0 | 32.7 | 32.7 | 40.3 | 40.3 | NA | **1248** | **289** | 242 | **484** |
| Montenegro | 444 | 29.5 | 23.0 | 23.4 | 30.2 | 30.6 | 33.3 | 452 | 672 | 136 | 136 |
| Netherlands | 15 534 | 30.1 | 22.7 | 29.5 | 25.2 | 32.3 | 16.4 | 24 043 | 1438 | 5015 | 5015 |
| Norway | 6256 | 28.6 | 24.0 | 30.1 | 26.8 | 33.5 | 20.6 | 9000 | 1931 | 2098 | 2098 |
| Poland | 8836 | 34.7 | 25.9 | 32.1 | 30.9 | 37.8 | 17.2 | **17 434** | **453** | 3500 | **4586** |
| Portugal | 5427 | 32.2 | 24.8 | 27.4 | 30.6 | 33.5 | 20.5 | 7197 | 672 | 1985 | 1985 |
| Romania | 858 | 44.3 | **33.1** | **37.3** | NA | NA | NA | **1496** | **67** | **393** | **511** |
| Russia | 26 325 | 34.0 | 24.5 | 26.7 | 30.5 | 33.1 | 19.4 | **54 219** | **387** | 9640 | **15 531** |



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Serbia | 1460 | 34.3 | 26.5 | 26.5 | 33.2 | 33.2 | NA | **2078** | **282** | 484 | **678** |
| Slovenia | 3515 | 30.2 | 24.2 | 27.9 | 27.9 | 32.0 | 20.7 | 4402 | 2195 | 1131 | 1131 |
| Spain | 28 874 | 32.9 | 19.5 | 24.1 | 24.2 | 29.7 | 20.2 | **85 749** | **2116** | 13 394 | **20 806** |
| Sweden | 10 847 | 31.5 | 24.4 | 34.1 | 26.1 | 36.3 | 22.4 | 17 595 | 1942 | 4053 | 4053 |
| Switzerland | 5193 | 23.6 | 18.1 | 28.6 | 21.8 | 33.4 | 16.4 | **9922** | **1305** | 1733 | **1802** |
| Ukraine | 5122 | 37.3 | 29.2 | 34.1 | 36.8 | 42.7 | 25.6 | **12 199** | **267** | 2457 | **4232** |
| UK | 41 898 | 31.1 | 27.3 | 32.2 | 33.3 | 39.0 | 24.4 | 57 482 | 941 | 17 207 | 17 207 |
| Argentina | 5036 | 25.3 | 19.7 | 24.4 | 23.8 | 29.6 | 23.8 | **18 907** | **462** | 2219 | **4942** |
| Brazil | 12 881 | 29.3 | 22.7 | 26.5 | 28.8 | 33.6 | 24.4 | **32 377** | **163** | 4966 | **8868** |
| Chile | 1198 | 27.0 | 21.0 | 24.8 | 26.1 | 31.0 | 22.7 | **2165** | **130** | 439 | **564** |
| Colombia | 716 | 28.6 | 21.9 | 26.7 | 28.5 | 34.2 | 32.3 | **1664** | **38** | 400 | **550** |
| Dominican Republic | 69 | 17.4 | 13.0 | 14.5 | 21.7 | 23.2 | 50.0 | 78 | 8 | 18 | 18 |
| Ecuador | 285 | 31.9 | 24.6 | 28.1 | 33.0 | 37.9 | 17.7 | **797** | **55** | 164 | **262** |
| Guatemala | 84 | 27.4 | 21.4 | 23.8 | 42.9 | 46.4 | 25.0 | **228** | **17** | 48 | **96** |
| Mexico | 2761 | 34.9 | 25.7 | 31.1 | 33.6 | 40.3 | 29.0 | **15 784** | **142** | 1682 | **5921** |
| Nicaragua | 88 | 36.4 | 31.8 | 31.8 | 39.8 | 39.8 | NA | 96 | 16 | 39 | 39 |
| Panama | 177 | 34.5 | 30.5 | 35.6 | 40.1 | 46.9 | 44.4 | 287 | 85 | 100 | 100 |
| Peru | 1149 | 25.8 | 18.5 | 22.0 | 23.5 | 27.6 | 45.2 | **4488** | **152** | 798 | **1596** |
| Uruguay | 233 | 34.3 | 22.7 | 25.8 | 27.5 | 33.9 | 32.6 | **537** | **154** | 106 | **159** |
| Venezuela | 612 | 37.6 | 29.4 | 34.8 | 35.9 | 42.0 | 30.3 | **1287** | **48** | 459 | **536** |
| Egypt | 6803 | 36.2 | 25.7 | 28.3 | 34.2 | 38.1 | 16.8 | **132 820** | **1684** | 2613 | **40 502** |
| Lebanon | 1078 | 21.8 | NA | NA | NA | NA | NA | **13 350** | **3323** | 75 | **750** |
| Tunisia | 1674 | 30.4 | 24.2 | 27.8 | 30.8 | 35.4 | 26.0 | **16 336** | **1558** | 592 | **4736** |
| Israel[a] | **27 911** | **23.1** | **17.3** | **21.5** | NA | NA | NA | 34 538 | 4775 | **7372** | **7372** |
| Canada | 11 370 | 36.6 | 28.5 | 37.0 | 35.5 | 45.9 | 26.9 | 17 926 | 535 | 5680 | 5680 |
| USA | 81 075 | 42.8 | 34.6 | 45.5 | 45.6 | 59.2 | 42.8 | **176 214** | **574** | 59 476 | **76 194** |
| Cameroon | 96 | 20.8 | 20.8 | 20.8 | NA | NA | NA | **218** | **12** | 1 | **2** |
| Mali[a] | 171 | 24.0 | **18.1** | **18.1** | NA | NA | NA | **184** | **14** | **38** | **38** |
| South Africa | 4352 | 31.8 | **23.8** | **23.8** | NA | NA | NA | **6701** | **137** | **1269** | **1813** |
| **Region** | **Fresh IVF and ICSI** | | | | | | **FET** | | | | |
| | **Aspirations[a]** | **PR/ Asp[b] (%)** | **DR/ Asp[c] (%)** | **DR/Asp[d] Cumul. (%)** | **Babies[e] /Asp fresh (%)** | **Babies[e] /Asp Cumul. (%)** | **Babies[e] /FET (%)** | **Estimated[f] or reported overall total number of cycles** | **Availability[g] cycles/million** | **Total[h,j] babies reported from participating clinics** | **Total[i,j] babies estimated from all clinics** |
| Asia | 208 686 | 15.5 | 9.7 | 20.4 | 9.9 | 22.4 | 25.4 | 446 468 | 244 | >41 657 | >73 191 |
| Australia and New Zealand | 33 185 | 26.7 | 20.4 | 32.3 | 22.2 | 35.1 | 22.2 | 59 534 | 2337 | 12 188 | 12 188 |

*Continued*



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table Ic** *Continued*

| Country name | Fresh IVF and ICSI | | | | | | FET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aspirations[a] | PR/ Asp[b] (%) | DR/ Asp[c] (%) | DR/Asp[d] Cumul. (%) | Babies[e] /Asp fresh (%) | Babies[e] /Asp Cumul. (%) | Babies[e] /FET (%) | Estimated[f] or reported overall total number of cycles | Availability[g] cycles/million | Total[h,j] babies reported from participating clinics | Total[i,j] babies estimated from all clinics |
| Europe | 379 936 | 29.6 | 21.8 | 26.1 | 26.4 | 31.4 | 17.9 | 660 472 | 932 | 129 483 | 158 247 |
| Latin America | 25 289 | 29.1 | 22.4 | 26.6 | 28.3 | 33.6 | 25.6 | 78 695 | 152 | 11 438 | 23 651 |
| Middle East | 9555 | 33.6 | 25.4 | 28.2 | 33.5 | 37.5 | 18.3 | 162 506 | 1740 | 3280 | 45 988 |
| Middle East (Israel) | 27 911 | 23.1 | 17.3 | 21.5 | NA | NA | NA | 34 538 | 4775 | 7372 | 7372 |
| North America | 92 445 | 42.0 | 33.9 | 44.5 | 44.4 | 57.5 | 40.5 | 194 140 | 570 | 65 156 | 81 874 |
| Sub-Saharan Africa | 4619 | 31.3 | 23.5 | 23.5 | NA | NA | NA | 7103 | 87 | 1308 | 1853 |
| Total | 78 1626 | 27.0 | 20.1 | 27.1 | 24.6 | 32.9 | 24.0 | 1 643 456 | 474 | >271 882 | >404 364 |

ICMART, International Committee for Monitoring Assisted Reproductive Technologies; FET, frozen embryo transfer; PR, pregnancy rate; DR, delivery rate; Asp, aspiration; NA, not available.
Cumul., Cumulative rate per aspiration, computed by adding the FET deliveries and babies to those obtained after fresh cycle, the sum being divided by the number of aspirations.
The total numbers and numbers by region were calculated only from the countries with complete data (e.g. both number of pregnancies and number of oocyte aspirations).
[a–j]Imputed/estimated data printed in bold.
[a]Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.
[b]Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.
[c]Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.
[d]Imputed by calculating the mean percentage of deliveries per pregnancy.
[e]In countries where the sum of singleton, twins and triplets were less than the total number of deliveries, the number of unknown babies and lost to follow-up deliveries were estimated by applying distribution of observed deliveries in which this was known.
[f]Initiated cycles overall countries estimation. Step 1: Reported cycles for countries reporting them, or estimation by applying their cancellation rate to the aspiration numbers for the countries not reporting them. Step 2: Total of Step 1 if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[g]Total estimated number of cycles in the country divided by its population in 2010 (CIA World Fact Book).
[h]Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.
[i]Total babies reported if 100% of the clinics reported, or estimation by applying the percentage of participating clinics to this total in the other situations.
[j]Total babies also includes PGD and oocyte donation (OD).



Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIa Fresh non-donor IVF and ICSI cycles: number of transferred embryos and multiple births for year 2008.**

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| India | NA | NA | 7.8 | 24.6 | 46.3 | 21.3 | 2.89 | 23.5 | 4.6 |
| Japan | 125 727 | 63 034 | 59.9 | 35.6 | 4.3 | 0.3 | 1.45 | 7.4 | 0.1 |
| South Korea | 20 901 | 19 708 | 9.8 | 19.0 | 42.6 | 28.6 | 2.97 | 34.4 | 0.7 |
| Australia | 30 740 | 26 327 | 63.8 | 35.3 | 0.8 | 0.1 | 1.37 | 8.5 | 0.2 |
| New Zealand | 2667 | 2383 | 59.9 | 37.5 | 2.6 | 0.0 | 1.43 | 7.8 | 0.1 |
| Albania | 143 | 139 | 5.0 | 23.7 | 71.2 | 0.0 | 2.66 | 32.6 | 4.7 |
| Austria | 5320 | 5219 | 22.6 | 68.9 | 8.3 | 0.2 | 1.86 | NA | NA |
| Belgium | 16 840 | 15 341 | 50.4 | 39.8 | 8.1 | 1.6 | 1.61 | 11.5 | 0.2 |
| Bosnia and Herzegovina | 167 | 150 | 52.0 | 40.7 | 7.3 | 0.0 | 1.55 | 6.7 | NA |
| Bulgaria | 2891 | 2701 | 17.9 | 28.8 | 39.6 | 13.6 | 2.49 | 26.3 | 1.8 |
| Czech Republic | 11 788 | 10 332 | 19.6 | 70.6 | 9.6 | 0.2 | 1.91 | NA | NA |
| Denmark | 10 209 | 8751 | 39.6 | 54.1 | 6.3 | 0.0 | 1.67 | 16.6 | 0.1 |
| Estonia | 1620 | 1511 | 21.1 | 72.7 | 6.2 | 0.0 | 1.85 | 23.8 | 0.4 |
| Finland | 4871 | 4392 | 62.1 | 37.7 | 0.2 | 0.0 | 1.38 | 9.3 | 0.0 |
| France | 51 534 | 43 544 | 26.1 | 61.1 | 11.9 | 0.9 | 1.88 | 18.2 | 0.4 |
| Germany | 46 431 | 43 336 | 12.5 | 67.6 | 19.9 | 0.0 | 2.07 | 21.1 | 0.9 |
| Greece | 1981 | 1687 | 19.0 | 25.5 | 46.9 | 8.5 | 2.45 | 22.0 | 1.8 |
| Hungary | 2431 | 2221 | 7.3 | 59.0 | 29.1 | 4.6 | 2.31 | 19.8 | 1.6 |
| Iceland | 411 | 334 | 48.5 | 45.8 | 5.7 | 0.0 | 1.57 | 11.1 | 0.0 |
| Ireland | 2428 | 2207 | 19.1 | 72.6 | 8.2 | 0.1 | 1.89 | 20.6 | 1.3 |
| Italy | 39 434 | 34 179 | 20.0 | 30.7 | 49.4 | 0.0 | 2.29 | 21.2 | 2.7 |
| Kazakhstan | 1005 | 947 | 13.9 | 49.0 | 33.8 | 3.3 | 2.27 | 28.4 | 1.4 |
| Latvia | 176 | 169 | 15.4 | 59.2 | 25.4 | 0.0 | 2.10 | NA | NA |
| Lithuania | 421 | 401 | 3.0 | 9.0 | 46.3 | 41.8 | 3.27 | 29.4 | 5.9 |
| Macedonia | 1424 | 1172 | 16.7 | 24.8 | 56.7 | 1.8 | 2.44 | 28.8 | 4.8 |
| Moldova | 582 | 551 | 7.8 | 24.0 | 56.1 | 12.2 | 2.75 | 24.2 | 0.9 |
| Montenegro | 324 | 304 | 12.5 | 22.4 | 58.2 | 6.9 | 2.60 | 31.1 | 0.0 |
| Netherlands | 15 710 | 13 972 | NA | NA | NA | NA | NA | 13.9 | 0.1 |
| Norway | 5685 | 5055 | 52.9 | 46.4 | 0.8 | 0.0 | 1.48 | 12.0 | 0.2 |
| Poland | 6589 | 5963 | 18.2 | 68.2 | 12.9 | 0.7 | 1.96 | 20.4 | 0.5 |
| Portugal | 4197 | 3779 | 19.0 | 69.6 | 11.4 | 0.0 | 1.92 | 20.5 | 0.1 |
| Romania | 954 | 891 | 8.8 | 39.6 | 42.2 | 9.4 | 2.53 | 46.7 | NA |
| Russia | 24 466 | 22 511 | 15.6 | 59.9 | 20.3 | 4.2 | 2.14 | 23.8 | 1.2 |
| Serbia | 1503 | 1275 | 13.3 | 77.1 | 6.9 | 2.7 | 1.99 | 9.0 | 3.3 |
| Slovenia | 2862 | 2492 | 30.4 | 67.0 | 2.6 | 0.0 | 1.72 | 18.9 | 0.4 |
| Spain | 23 522 | 21 042 | NA | NA | NA | NA | NA | 23.8 | 0.9 |
| Sweden | 10 326 | 9161 | 69.5 | 30.5 | 0.0 | 0.0 | 1.31 | 7.0 | 0.1 |
| Switzerland | 4519 | 3970 | 14.7 | 66.8 | 18.6 | 0.0 | 2.04 | 20.3 | 0.5 |
| Turkey | 43 928 | 39 619 | 12.8 | 24.4 | 52.8 | 10.1 | 2.60 | 32.9 | 5.2 |
| Ukraine | 5608 | 5189 | 11.5 | 44.7 | 38.2 | 5.7 | 2.39 | 27.2 | 0.5 |
| UK | 36 556 | 33 558 | 15.4 | 79.4 | 5.1 | 0.0 | 1.90 | 24.5 | 0.4 |
| Argentina | 5412 | 4743 | 14.4 | 48.3 | 33.2 | 4.2 | 2.27 | 19.0 | 1.2 |
| Bolivia | 48 | 45 | 8.9 | 26.7 | 44.4 | 20.0 | 2.76 | 40.0 | 0.0 |
| Brazil | 11 434 | 9996 | 10.2 | 35.1 | 36.8 | 17.9 | 2.64 | 24.1 | 6.0 |
| Chile | 1258 | 1105 | 10.0 | 56.6 | 30.7 | 2.7 | 2.27 | 25.1 | 0.8 |
| Colombia | 988 | 865 | 15.5 | 40.2 | 29.6 | 14.7 | 2.47 | 22.9 | 1.4 |

*Continued*

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIa** *Continued*

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Ecuador | 262 | 171 | 6.4 | 53.8 | 34.5 | 5.3 | 2.39 | 42.1 | 0.0 |
| Guatemala | 56 | 51 | 15.7 | 29.4 | 21.6 | 33.3 | 2.75 | 16.7 | 8.3 |
| Mexico | 2766 | 2536 | 11.1 | 25.8 | 52.5 | 10.5 | 2.64 | 20.8 | 2.8 |
| Peru | 805 | 695 | 17.0 | 67.9 | 12.4 | 2.7 | 2.01 | 24.3 | 0.0 |
| Uruguay | 219 | 190 | 15.8 | 37.9 | 34.7 | 11.6 | 2.43 | 19.6 | 5.4 |
| Venezuela | 729 | 668 | 13.6 | 46.9 | 37.3 | 2.2 | 2.28 | 23.5 | 1.1 |
| Egypt | 10 311 | 9386 | 5.3 | 14.5 | 62.8 | 17.4 | 2.96 | 29.0 | 1.0 |
| Lebanon | 798 | 747 | 21.6 | 24.2 | 21.9 | 32.3 | 2.82 | 25.6 | 0.6 |
| Saudi Arabia | 346 | 320 | 8.5 | 7.8 | 58.6 | 25.1 | 3.01 | 26.9 | 2.2 |
| Israel | NA | 18 839 | NA | NA | NA | NA | NA | NA | NA |
| Canada | 9401 | 8704 | 12.2 | 57.1 | 21.4 | 9.3 | 2.30 | 27.9 | 1.0 |
| USA | 82 097 | 75 758 | 11.2 | 50.1 | 24.8 | 14.0 | 2.46 | 29.9 | 1.8 |
| **Region** | **Aspirations** | **Transfers** | **Number of transferred embryos (%)** | | | | | **Multiple births** | |
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Asia | >146 628 | >82 742 | 43.2 | 30.8 | 17.3 | 8.6 | 1.94 | 15.2 | 1.3 |
| Australia and New Zealand | 33 407 | 28 710 | 63.5 | 35.5 | 0.9 | 0.1 | 1.38 | 8.4 | 0.2 |
| Europe | 388 856 | 348 065 | 22.4 | 53.2 | 22.3 | 2.1 | 2.04 | 20.7 | 1.1 |
| Latin America | 23 977 | 21 065 | 11.8 | 39.9 | 36.4 | 11.9 | 2.50 | 22.8 | 3.8 |
| Middle East | 11 455 | 10 453 | 6.6 | 15.0 | 59.8 | 18.7 | 2.95 | 28.7 | 1.1 |
| Middle East (Israel) | NA | 18 839 | NA | NA | NA | NA | NA | NA | NA |
| North America | 91 498 | 84 462 | 11.3 | 50.8 | 24.4 | 13.5 | 2.45 | 29.7 | 1.7 |
| Total | >695 821 | >594 336 | 25.7 | 46.8 | 21.9 | 5.6 | 2.09 | 21.8 | 1.3 |

NA, not available.
[a]Average number of transferred embryos was calculated using number of 1, 2, 3, 4 and ≥5 transferred embryos and for '≥5' we assumed that it is '=5'.

FET cycles increased substantially during the period of observation: from 204 427 cycles to 260 861 cycles equaling a 27.6% increase. The percentage of frozen thaw cycles over all autologous initiated cycles (fresh and frozen) increased from 22.4% in 2008 to 26.5% in 2010. Japan and the USA, followed by Australia, conducted the largest number of FET cycles (Supplementary data, Tables SIIa–SIIc). Fertilization by ICSI (for calculating the rate of fertilization by ICSI countries reporting total ART cycles without separating IVF and ICSI data were excluded in order to avoid an underestimate of the ICSI fertilization rate) remained relatively constant and similar to the figure of 65.2% reported in 2007, namely 67.5% in 2008; 66.0% in 2009; and 67.4% in 2010, however with large variations by region and country.

## Effectiveness

The global pregnancy rate (PR) and DR per aspiration for non-donor IVF during the triennium was 26.1 and 19.1% for 2008; 26.1 and 18.9% for 2009; and 25.4 and 19.1% for 2010, respectively. For ICSI, the global PR and DR was 28.7 and 18.9% for 2008; 27.7 and 19.9% for 2009; and 26.8 and 20.0% for 2010, respectively (Supplementary data, Table SIIIa–SIIIc). The average number of embryos transferred in fresh non-donor IVF and ICSI cycles was 2.1 in 2008, 2.0 in 2009 and 1.9 in 2010, thereby continuing the steady decrease from previous years (Mansour *et al.*, 2014; Ishihara *et al.*, 2015; Tables IIa–IIc; Supplementary data, Fig. S1a–c).

Following a similar trend of gradual but continuous decrease, the average number of embryos transferred in FET cycles fell from 1.72 (2008) to 1.65 (2009) and then to 1.60 (2010) (Supplementary data, Tables SIVa–SIVc). The global PR and DR following FET was 27.3 and 18.8% for 2008; 27.9 and 19.7% for 2009; and reached 29.1 and 20.7% in 2010, respectively (Supplementary data, Tables IIIa–IIIc). Fresh and frozen transfers combined gave rise to a global estimated cumulative DR per aspiration of 25.7% in 2008; 26.1% in 2009; and 27.1% in 2010, ranging regionally from 17.8% in Asia (2008) to 44.5% in North America (2010) (Tables Ia–Ic). Considerable variation was also observed in the measures of effectiveness among countries. Such differences reflect the great international heterogeneity in socioeconomic, demographic and other factors as well as quality of health care and clinical ART practice.

Early pregnancy loss in fresh cycles occurred at a rate of 21.8% (2008); 21.1% (2009); and 20.2% (2010) (regional range from 18.3% [Latin America, 2008] to 38.0% [Asia, 2008]). Corresponding early pregnancy loss rates for FET were 28.9% (2008); 25.4% (2009); and 25.2% (2010) with a regional range from 20.9% (USA, 2010) to 36.6% (Asia, 2008).

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIb Fresh non-donor IVF and ICSI cycles: number of transferred embryos and multiple births for year 2009.**

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| India | 19 626 | 18 820 | 9.7 | 24.8 | 43.1 | 22.4 | 2.85 | 22.8 | 3.1 |
| Indonesia | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Japan | 134 473 | 63 242 | 67.3 | 30.9 | 1.6 | 0.1 | 1.35 | 7.8 | 0.1 |
| South Korea | 20 869 | 19 424 | 13.6 | 28.4 | 40.4 | 17.6 | 2.66 | 29.6 | 0.5 |
| Australia | 35 875 | 30 659 | 65.1 | 34.0 | 0.8 | 0.0 | 1.36 | 9.0 | 0.2 |
| New Zealand | 2895 | 2615 | 62.1 | 35.4 | 2.3 | 0.1 | 1.40 | 7.9 | 0.0 |
| Austria | 5766 | 5376 | 22.5 | 68.2 | 8.6 | 0.6 | 1.87 | 21.8 | 0.8 |
| Belgium | 17 802 | 16 088 | 48.9 | 40.7 | 8.6 | 1.8 | 1.64 | 11.7 | 0.2 |
| Bulgaria | 1579 | 1443 | 9.1 | 32.4 | 47.5 | 10.9 | 2.60 | 12.5 | 2.7 |
| Croatia | 3099 | 2774 | NA | NA | NA | NA | NA | 18.4 | 2.7 |
| Cyprus | 1202 | NA | NA | NA | NA | NA | NA | NA | NA |
| Czech Republic | 11 706 | 10 146 | NA | NA | NA | NA | NA | NA | NA |
| Denmark | 11 145 | 9664 | 42.0 | 52.1 | 6.0 | 0.0 | 1.64 | 16.0 | 0.0 |
| Finland | 4424 | 3981 | 65.7 | 34.1 | 0.2 | 0.0 | 1.34 | 8.4 | 0.1 |
| France | 56 234 | 47 822 | 27.1 | 61.8 | 10.3 | 0.8 | 1.85 | 18.0 | 0.3 |
| Germany | 49 436 | 45 476 | 13.3 | 68.1 | 18.7 | 0.0 | 2.05 | 20.1 | 0.8 |
| Greece | 1903 | 1481 | 21.7 | 31.0 | 40.9 | 6.4 | 2.32 | 27.6 | 2.8 |
| Hungary | 6215 | 5693 | 14.5 | 55.7 | 27.2 | 2.6 | 2.18 | NA | NA |
| Iceland | 463 | 389 | 43.2 | 56.8 | 0.0 | 0.0 | 1.57 | 14.6 | 0.0 |
| Ireland | 2736 | 2487 | 25.7 | 65.9 | 8.3 | 0.0 | 1.83 | 21.9 | 1.0 |
| Italy | 43 243 | 37 301 | 19.0 | 33.6 | 44.8 | 2.6 | 2.31 | 21.1 | 2.4 |
| Kazakhstan | 941 | 878 | 13.9 | 43.5 | 39.1 | 3.6 | 2.32 | 36.4 | 1.7 |
| Latvia | 491 | 440 | 23.0 | 63.9 | 13.2 | 0.0 | 1.90 | NA | NA |
| Lithuania | 115 | 114 | 9.6 | 13.2 | 36.0 | 41.2 | 3.09 | 33.3 | 6.7 |
| Macedonia | 1858 | 1703 | 14.9 | 29.5 | 55.6 | 0.0 | 2.41 | 32.2 | 1.9 |
| Moldova | 596 | 554 | 8.7 | 25.1 | 54.5 | 11.7 | 2.71 | 21.2 | 1.4 |
| Montenegro | 430 | 398 | 16.3 | 29.1 | 49.5 | 5.0 | 2.43 | 20.4 | 1.5 |
| Netherlands | 15 553 | 13 888 | NA | NA | NA | NA | NA | 11.2 | 0.1 |
| Norway | 6179 | 5451 | 53.4 | 45.7 | 0.9 | 0.0 | 1.48 | 11.6 | 0.1 |
| Poland | 7741 | 6884 | 20.7 | 67.4 | 11.3 | 0.6 | 1.92 | 16.9 | 0.8 |
| Portugal | 4423 | 3877 | 20.6 | 71.2 | 7.9 | 0.3 | 1.88 | 22.1 | 0.9 |
| Romania | 912 | 875 | 14.1 | 39.9 | 34.3 | 11.8 | 2.45 | 28.3 | 4.3 |
| Russia | 31 661 | 29 208 | 16.4 | 60.5 | 19.4 | 3.6 | 2.11 | 25.6 | 1.3 |
| Serbia | 1180 | 1092 | 15.7 | 20.7 | 42.4 | 21.2 | 2.69 | 31.0 | 6.4 |
| Slovenia | 2806 | 2513 | 30.4 | 66.9 | 2.6 | 0.0 | 1.72 | 17.6 | 0.1 |
| Spain | 30 311 | 26 583 | 15.6 | 68.2 | 16.1 | 0.0 | 2.00 | 23.3 | 0.6 |
| Sweden | 10 824 | 9614 | 70.7 | 29.3 | 0.0 | 0.0 | 1.29 | 5.9 | 0.2 |
| Switzerland | 4852 | 4170 | 16.9 | 64.9 | 18.2 | 0.0 | 2.01 | 19.7 | 0.1 |
| Ukraine | 5768 | 5334 | 10.6 | 50.4 | 35.2 | 3.7 | 2.32 | 24.4 | 1.9 |
| UK | 39 850 | 36 594 | 22.7 | 72.1 | 5.3 | 0.0 | 1.83 | 22.4 | 0.4 |
| Argentina | 5781 | 5018 | 13.9 | 53.8 | 29.2 | 3.1 | 2.22 | 15.5 | 1.4 |
| Bolivia | 69 | 66 | 13.6 | 19.7 | 54.5 | 12.1 | 2.68 | 0.0 | 0.0 |
| Brazil | 11 320 | 9717 | 12.3 | 37.3 | 35.5 | 14.9 | 2.54 | 22.7 | 2.6 |
| Chile | 1273 | 1106 | 12.0 | 59.0 | 26.6 | 2.4 | 2.20 | 24.7 | 1.6 |
| Colombia | 972 | 840 | 14.3 | 42.4 | 33.2 | 10.1 | 2.43 | 26.6 | 2.3 |
| Ecuador | 232 | 196 | 9.7 | 50.5 | 34.7 | 5.1 | 2.35 | 11.3 | 0.0 |

*Continued*

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIb** *Continued*

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Guatemala | 82 | 77 | 5.2 | 40.3 | 36.4 | 18.2 | 2.68 | 12.5 | 0.0 |
| Mexico | 2973 | 2489 | 11.5 | 28.4 | 49.2 | 11.0 | 2.61 | 25.9 | 2.7 |
| Peru | 873 | 721 | 11.9 | 67.7 | 17.1 | 3.3 | 2.12 | 22.6 | 1.7 |
| Uruguay | 276 | 242 | 13.6 | 44.2 | 33.5 | 8.7 | 2.37 | 11.3 | 1.4 |
| Venezuela | 1079 | 918 | 13.1 | 54.6 | 31.7 | 0.7 | 2.20 | 19.6 | 0.8 |
| Egypt | 7824 | 7129 | 8.2 | 21.8 | 60.4 | 9.7 | 2.73 | 25.4 | 0.8 |
| Lebanon | 847 | 764 | 19.6 | 20.1 | 19.3 | 41.0 | 3.08 | 32.6 | 6.3 |
| Palestinian Territory | 174 | 164 | 8.5 | 15.2 | 12.2 | 64.0 | 3.58 | 29.1 | 21.8 |
| Tunisia | 2797 | 2611 | 15.0 | 45.1 | 22.1 | 17.9 | 2.46 | 17.9 | 0.4 |
| Israel | NA | 21 017 | NA | NA | NA | NA | NA | NA | NA |
| Canada | 9955 | 9274 | 13.9 | 57.1 | 21.4 | 7.7 | 2.25 | 27.4 | 0.9 |
| USA | 81 358 | 75 745 | 13.0 | 51.8 | 23.4 | 11.8 | 2.38 | 28.9 | 1.6 |
| Cameroon | 107 | 94 | 13.6 | 29.1 | 38.2 | 19.1 | 2.66 | 15.4 | 0.0 |
| South Africa | 3305 | 2813 | 12.8 | 54.1 | 25.1 | 8.0 | 2.28 | NA | NA |
| Togo | 109 | 99 | 25.3 | 27.3 | 34.3 | 13.1 | 2.35 | 6.7 | 0.0 |
| **Region** | **Aspirations** | **Transfers** | **Number of transferred embryos (%)** | | | | | **Multiple births** | |
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Asia | >174 968 | >101 486 | 46.6 | 29.3 | 16.6 | 7.5 | 1.87 | 15.3 | 1.1 |
| Australia and New Zealand | 38 770 | 33 274 | 64.9 | 34.1 | 0.9 | 0.1 | 1.36 | 8.9 | 0.2 |
| Europe | 383 444 | >340 291 | 24.3 | 57.3 | 17.2 | 1.2 | 1.95 | 19.4 | 0.8 |
| Latin America | 24 930 | 21 390 | 12.6 | 43.4 | 34.3 | 9.7 | 2.42 | 21.5 | 2.2 |
| Middle East | 11 642 | 10 668 | 10.7 | 27.3 | 47.3 | 14.8 | 2.70 | 23.6 | 1.4 |
| Middle East (Israel) | NA | 21 017 | NA | NA | NA | NA | NA | NA | NA |
| North America | 91 313 | 85 019 | 13.1 | 52.4 | 23.2 | 11.3 | 2.36 | 28.7 | 1.5 |
| Sub-Saharan Africa | 3521 | 3006 | 13.2 | 52.3 | 25.9 | 8.6 | 2.30 | 10.7 | 0.0 |
| Total | >728 588 | >616 151 | 28.3 | 49.0 | 18.3 | 4.4 | 2.00 | 20.5 | 1.0 |

NA, not available.
[a]Average number of transferred embryos was calculated using number of 1, 2, 3, 4 and ≥5 transferred embryos and for '≥5' we assumed that it is '=5'.

While the data were not stratified by age, the proportion of women ≥40 years is an important variable that may influence country variations (Supplementary data, Tables SVa–SVc).

From 2008 through 2010, participating clinics reported 803 792 babies born: 264 495 in 2008; 267 385 in 2009; and 271 882 in 2010. Including estimations from non-reporting clinics resulted in an estimated total of 1 144 858 babies born in these 3 years, namely 357 264 in 2008; 383 230 in 2009; and 404 364 in 2010, respectively (Tables Ia–Ic). The annual increase from each preceding year of babies estimated born was, in chronological order, 14.6, 7.3 and 5.5%, averaging 9.1% per year for the period of observation.

The proportion of women ≥40 years undergoing aspiration in non-donor IVF or ICSI cycles continued to increase: from 20.8% in 2008 to 23.2% in 2010 with a comparative rate of 15.5% in 2006. This increase was observed in every region. The PR and DR in this age group was 11.6 and 6.5% in 2008; 13.5 and 7.5% in 2009; and 11.7 and 6.6% in 2010, respectively (Supplementary data, Tables SVIa–SVIc). For non-donor FET cycles, the proportion of women ≥40 years reached 18.7% in 2010 (from 16.4% in 2008) with PRs close to 20% and DRs of just over 11% in all 3 years (Supplementary data, Tables SVIIa–SVIIc).

## Safety

In fresh non-donor IVF and ICSI cycles, the global rate of single embryo transfer (SET) increased from 25.7% (2008) to 28.3% (2009) and then to 30.0% (2010). In the same period, the transfer of three embryos dropped from 21.9 to 16.7%; and that of four or more embryos from 5.6 to 4.0% (Tables IIa–IIc). The highest rates of SET were found in 2010 and reported from Sweden (73.3%), Japan (70.0%) and Finland (67.5%). Throughout the triennium, the highest regional rates of SET were recorded in Australia/New Zealand (63.5; 64.9; 64.4%) followed by Asia (43.2; 46.6; 51.2%). Percentage of transfers with three embryos was highest in Middle East (59.8; 47.3; 48.8%) followed by Latin America (36.4; 34.3; 34.6%). By 2010, the transfer of four and more embryos was 10% (North America; sub-Saharan Africa) or less in all regions.

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIc Fresh non-donor IVF and ICSI cycles: number of transferred embryos and multiple births for year 2010.**

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| India | NA | 17 277 | NA | NA | NA | NA | NA | 21.8 | 3.5 |
| Indonesia | 1814 | NA | NA | NA | NA | NA | NA | NA | NA |
| Japan | 153 729 | 65 024 | 70.0 | 28.5 | 1.4 | 0.2 | 1.32 | 5.3 | 0.1 |
| South Korea | 23 202 | 20 903 | 14.0 | 36.3 | 37.3 | 12.5 | 2.51 | 22.6 | 0.7 |
| Taiwan | NA | 6475 | 9.2 | 21.8 | 31.6 | 37.4 | 2.97 | NA | NA |
| Australia | 30 335 | 25 985 | 64.6 | 34.3 | 1.1 | 0.1 | 1.37 | 8.2 | 0.1 |
| New Zealand | 2850 | 2535 | 61.8 | 36.6 | 1.5 | 0.1 | 1.40 | 8.8 | 0.1 |
| Austria | 5782 | 5428 | 26.5 | 66.6 | 6.4 | 0.5 | 1.81 | 23.1 | 0.6 |
| Belgium | 17 657 | 15 882 | 50.5 | 39.9 | 8.1 | 1.5 | 1.61 | 11.1 | 0.2 |
| Bulgaria | 4626 | 3724 | 15.8 | 33.5 | 39.3 | 11.4 | 2.46 | 35.8 | 2.2 |
| Czech Republic | 11 985 | 9915 | NA | NA | NA | NA | NA | NA | NA |
| Denmark | 11 721 | 9967 | 45.2 | 49.1 | 5.6 | 0.0 | 1.60 | 15.2 | 0.4 |
| Finland | 4663 | 4123 | 67.5 | 32.3 | 0.2 | 0.0 | 1.33 | 10.6 | 0.3 |
| France | 56 492 | 50 085 | 28.3 | 61.2 | 9.7 | 0.8 | 1.83 | 17.7 | 0.3 |
| Germany | 44 695 | 42 780 | 14.3 | 67.5 | 18.2 | 0.0 | 2.04 | 28.6 | 3.9 |
| Greece | 2413 | 2203 | 14.6 | 31.5 | 46.3 | 7.7 | 2.47 | 27.0 | 3.1 |
| Hungary | 5074 | 4800 | 12.6 | 52.8 | 30.9 | 3.7 | 2.26 | NA | NA |
| Iceland | 502 | 412 | 42.5 | 57.5 | 0.0 | 0.0 | 1.58 | 13.9 | 0.0 |
| Ireland | 2656 | 2425 | 28.0 | 63.3 | 8.5 | 0.2 | 1.81 | 19.0 | 0.7 |
| Italy | 47 449 | 40 468 | 19.2 | 38.2 | 38.1 | 4.4 | 2.28 | 20.4 | 1.9 |
| Kazakhstan | 1630 | 1499 | 19.1 | 46.3 | 32.4 | 2.2 | 2.18 | 23.4 | 1.0 |
| Lithuania | 110 | 110 | 6.4 | 17.3 | 76.4 | 0.0 | 2.70 | NA | NA |
| Macedonia | 1292 | 1182 | 18.2 | 42.2 | 39.6 | 0.0 | 2.21 | 32.6 | 1.6 |
| Moldova | 600 | 575 | 10.1 | 31.7 | 51.7 | 6.6 | 2.55 | 22.4 | 0.5 |
| Montenegro | 444 | 414 | 16.9 | 22.9 | 59.4 | 0.7 | 2.44 | 31.4 | 0.0 |
| Netherlands | 15 534 | 13 714 | NA | NA | NA | NA | NA | 10.5 | 0.1 |
| Norway | 6256 | 5417 | NA | NA | NA | NA | NA | 11.1 | 0.3 |
| Poland | 8836 | 7786 | 20.3 | 70.6 | 8.6 | 0.5 | 1.89 | 18.6 | 0.4 |
| Portugal | 5427 | 4752 | 19.7 | 73.5 | 6.8 | 0.0 | 1.87 | 20.2 | 0.7 |
| Romania | 858 | 816 | 7.5 | 43.3 | 28.4 | 20.8 | 2.65 | NA | NA |
| Russia | 26 325 | 23 825 | 16.1 | 63.2 | 17.8 | 2.9 | 2.08 | 22.1 | 1.1 |
| Serbia | 1460 | 1316 | 17.6 | 15.7 | 54.4 | 12.2 | 2.61 | 14.7 | 5.2 |
| Slovenia | 3515 | 3031 | 32.2 | 64.7 | 3.2 | 0.0 | 1.71 | 15.0 | 0.0 |
| Spain | 28 874 | 24 765 | 17.4 | 69.4 | 13.2 | 0.0 | 1.96 | 23.6 | 0.4 |
| Sweden | 10 847 | 9593 | 73.3 | 26.7 | 0.0 | 0.0 | 1.27 | 5.8 | 0.1 |
| Switzerland | 5193 | 4314 | 18.4 | 62.9 | 18.7 | 0.0 | 2.00 | 19.4 | 0.4 |
| Ukraine | 5122 | 4811 | 11.0 | 54.3 | 31.2 | 3.4 | 2.27 | 23.9 | 1.1 |
| UK | 41 898 | 38 408 | 29.9 | 65.0 | 5.1 | 0.0 | 1.75 | 19.6 | 0.3 |
| Argentina | 5036 | 4478 | 15.8 | 51.1 | 30.3 | 2.8 | 2.20 | 18.4 | 0.7 |
| Brazil | 12 881 | 10 670 | 12.1 | 41.3 | 36.2 | 10.5 | 2.46 | 22.2 | 2.1 |
| Chile | 1198 | 990 | 13.8 | 65.4 | 19.1 | 1.7 | 2.09 | 21.1 | 0.4 |
| Colombia | 716 | 610 | 11.1 | 52.5 | 33.9 | 2.5 | 2.28 | 26.1 | 0.6 |
| Dominican Republic | 69 | 54 | 27.8 | 29.6 | 25.9 | 16.7 | 2.31 | 44.4 | 11.1 |
| Ecuador | 285 | 249 | 6.8 | 52.6 | 35.7 | 4.8 | 2.39 | 34.3 | 0.0 |
| Guatemala | 84 | 75 | 2.7 | 48.0 | 34.7 | 14.7 | 2.64 | 16.7 | 5.6 |
| Mexico | 2761 | 2471 | 11.3 | 35.5 | 45.9 | 7.4 | 2.51 | 25.7 | 2.7 |

*Continued*

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

**Table IIc** *Continued*

| Country name | Aspirations | Transfers | Number of transferred embryos (%) | | | | | Multiple births | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Nicaragua | 88 | 86 | 9.3 | 17.4 | 73.3 | 0.0 | 2.64 | 25.0 | 0.0 |
| Panama | 177 | 156 | 10.9 | 64.1 | 25.0 | 0.0 | 2.14 | 31.5 | 0.0 |
| Peru | 1149 | 889 | 19.5 | 52.8 | 24.0 | 3.8 | 2.12 | 22.2 | 2.4 |
| Uruguay | 233 | 213 | 12.2 | 49.8 | 33.8 | 4.2 | 2.30 | 17.0 | 1.9 |
| Venezuela | 612 | 585 | 10.3 | 54.4 | 33.0 | 2.4 | 2.28 | 20.0 | 1.1 |
| Egypt | 6803 | 6151 | 16.8 | 16.8 | 57.5 | 8.9 | 2.59 | 31.0 | 1.2 |
| Lebanon | 1078 | 912 | NA | NA | NA | NA | NA | NA | NA |
| Tunisia | 1674 | 1510 | 18.8 | 64.5 | 13.4 | 3.2 | 2.01 | 26.2 | 0.5 |
| Israel | NA | 22 141 | NA | NA | NA | NA | NA | NA | NA |
| Canada | 11 370 | 10 418 | 24.6 | 51.7 | 16.8 | 6.9 | 2.08 | 23.0 | 0.7 |
| USA | 81 075 | 75 180 | 14.8 | 53.2 | 21.4 | 10.6 | 2.31 | 29.0 | 1.5 |
| Cameroon | 96 | 86 | 18.2 | 16.9 | 28.6 | 36.4 | 3.03 | 13.3 | 6.7 |
| Mali | 171 | 159 | NA | NA | NA | NA | NA | NA | NA |
| South Africa | 4352 | 3781 | 14.8 | 50.3 | 25.2 | 9.8 | 2.30 | NA | NA |
| **Region** | **Aspirations** | **Transfers** | **Number of transferred embryos (%)** | | | | | **Multiple births** | |
| | | | 1 | 2 | 3 | ≥4 | Average[a] | Twin (%) | Triplet+ (%) |
| Asia | >178 745 | >109 679 | 51.2 | 29.5 | 12.5 | 6.9 | 1.76 | 13.7 | 1.2 |
| Australia and New Zealand | 33 185 | 28 520 | 64.4 | 34.5 | 1.1 | 0.1 | 1.37 | 8.2 | 0.1 |
| Europe | 379 936 | 338 540 | 25.8 | 56.7 | 16.1 | 1.5 | 1.93 | 19.6 | 1.0 |
| Latin America | 25 289 | 21 526 | 13.0 | 45.2 | 34.6 | 7.2 | 2.36 | 22.2 | 1.7 |
| Middle East | 9555 | 8573 | 17.2 | 26.2 | 48.8 | 7.8 | 2.48 | 30.0 | 1.1 |
| Middle East (Israel) | NA | 22 141 | NA | NA | NA | NA | NA | NA | NA |
| North America | 92 445 | 85 598 | 16.0 | 53.0 | 20.9 | 10.1 | 2.28 | 28.4 | 1.4 |
| Sub-Saharan Africa | 4619 | 4026 | 14.9 | 49.5 | 25.3 | 10.3 | 2.31 | 13.3 | 6.7 |
| Total | >723 774 | >618 603 | 30.0 | 49.3 | 16.7 | 4.0 | 1.95 | 20.4 | 1.1 |

NA, not available.
[a]Average number of transferred embryos was calculated using number of 1, 2, 3, 4 and ≥5 transferred embryos and for '≥5' we assumed that it is '=5'.

The average number of embryos transferred in fresh non-donor IVF and ICSI cycles fell from 2.1 (2008) to 1.9 (2010) (country range 1.3 [Sweden; 2010] to 3.6 [Palestinian Territory; 2009]) (Tables IIa–IIc; Supplementary data, Fig. S1a–c). Three regions were consistently below the annual average (Australia/New Zealand; Europe and Asia) with the remaining regions being above. Only six countries transferred an average of three or more embryos annually: two countries in 2008; three countries in 2009 and one country in 2010 (Supplementary data, Fig. S1a–c).

The rate of SET in non-donor FET cycles was substantially higher when compared with fresh embryo transfer, increasing from 44.8 to 51.2%, with an interim rate of 48.3% in 2009. This was accompanied by a reduction in the average number of frozen embryos transferred from 1.7 to 1.6 (Supplementary data, Tables SIVa–SIVc).

The PRs and DRs by number of fresh and frozen embryos transferred are reported in Supplementary data, Tables SVIIIa–SVIIIc and SIXa–SIXc, respectively. The global DR for fresh non-donor SET was 18.4% in 2008; 19.3% in 2009; and 20.0% in 2010, with corresponding rates following double embryo transfer (DET) of 28.0, 27.5 and 29.0%. In non-donor FET cycles, similar DRs for SET were reported (18.1 in 2008; 19.6 in 2009 and 20.5 in 2010) when compared with fresh SET, however, the DR following DET was considerably lower (19.6% in 2008; 20.1% in 2009; and 21.4% in 2010). The DR per aspiration according to the mean number of embryos transferred by country is shown in Supplementary data, Fig. S2a–c. As in preceding years, there was no statistically significant correlation between the mean number of embryos transferred and the DR in 2008 ($r = 0.08$; $P = 0.56$) and 2009 ($r = 0.24$; $P = 0.08$); however, a positive correlation was found in 2010 ($r = 0.33$; $P = 0.017$), and the 2008–2009–2010 pooled data also showed significance ($r = 0.20$ and $P = 0.01$; Supplementary data, Fig. S3a–d). Furthermore, highly significant correlations existed in all 3 years between the mean number of embryos transferred and the rate of prematurity as well as multiple deliveries, as shown in Fig. 1a–c; and between the mean number of embryos transferred and triplet deliveries (Supplementary data, Fig. S4a–c).

The multiple birth rate (MBR) following fresh non-donor embryo transfer was 23.1% in 2008 and 21.5% in 2009 and 2010. The DR of twins and triplets specifically was 21.8 and 1.3% in 2008; 20.5 and

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

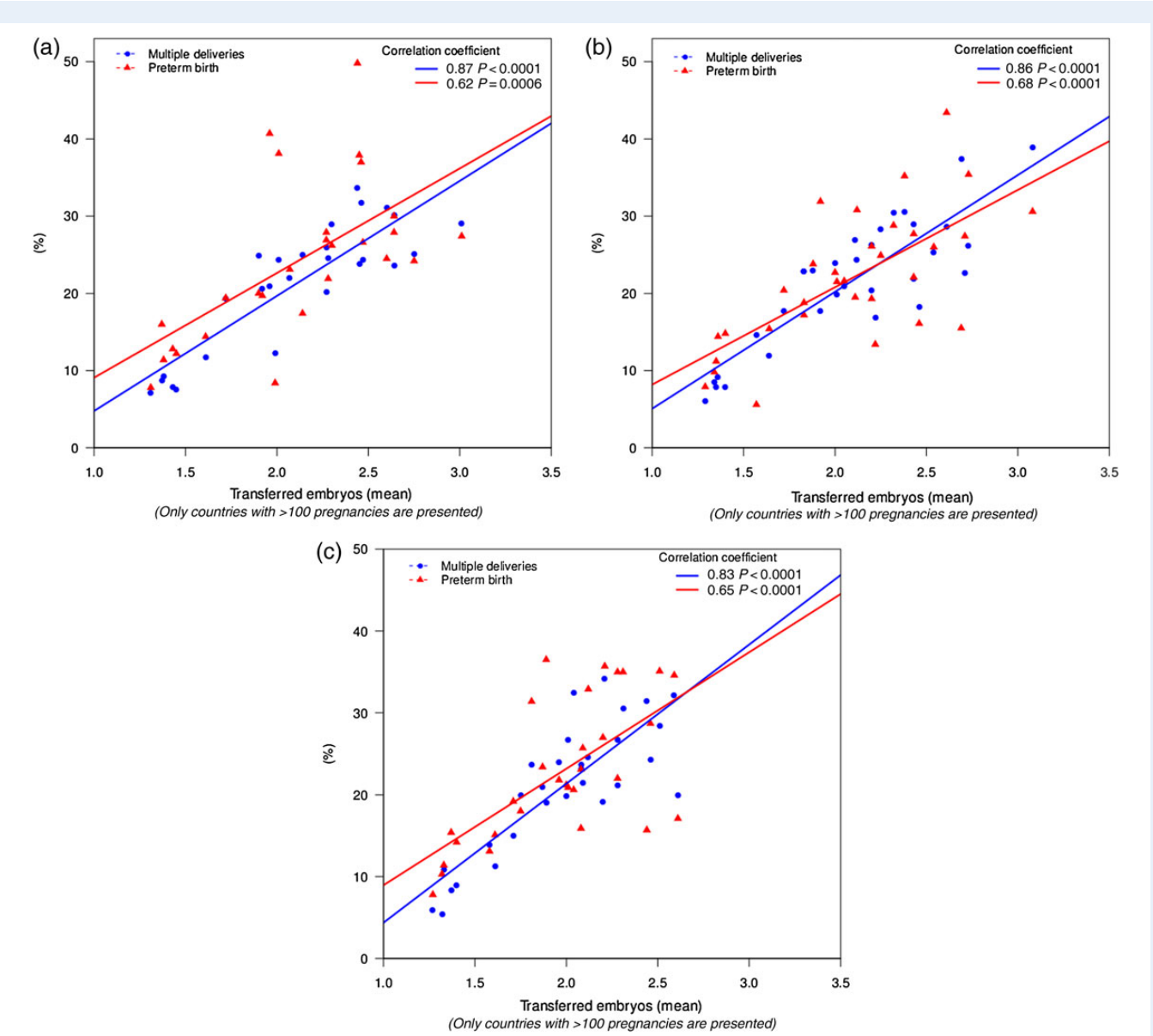


**Figure 1** (**a**) The correlation between rate of multiple deliveries/preterm births and mean number of embryos transferred for year 2008. (**b**) The correlation between rate of multiple deliveries/preterm births and mean number of embryos transferred for year 2009. (**c**) The correlation between rate of multiple deliveries/preterm births and mean number of embryos transferred for year 2010.

1.0% in 2009; and 20.4 and 1.1% in 2010, respectively. Substantial regional differences existed, however, resulting in a range for twin births from 8.2% (Australia/New Zealand; 2010) to 30.0% (Middle East; 2010); and for triplets from 0.1% (Australia/New Zealand; 2010) to 3.8% (Latin America; 2008). Even more pronounced differences existed at country level (see Tables IIa–IIc; Supplementary data, Fig. S5a–c). FET cycles had approximately half the MBR when compared with fresh embryo transfer, namely 13% (2008), 11.9% (2009) and 12% (2010), with a triplet DR of 0.6% or less in all 3 years (Supplementary data, Tables SIVa–SIVc).

In line with the MBR, premature delivery and perinatal mortality rates were lower for frozen when compared with fresh embryo transfer: preterm DRs following fresh embryo transfer were, in chronological order, 25.3, 23.7 and 23.3%; with comparative numbers following FET of 18.4%; 16.8 and 17.1%. With regard to perinatal mortality, the rates were 22.8, 19.3 and 21.0% per 1000 births following fresh embryo transfer; and 15.1, 13.9 and 14.6% per 1000 births resulting from FET (Supplementary data, Tables SVa–SVc).

The frequency of ovarian hyperstimulation syndrome fell from 0.8% of initiated cycles in 2008 to 0.5% in 2010 (Supplementary data, Tables SXa–SXc). Ovarian hyperstimulation was defined by severe illness or hospitalization.

## Special techniques: oocyte donation, PGD, *in vitro* maturation, surrogacy and fetal reduction

Data on oocyte donation were provided by 40 countries in 2008 and 2009 and by 41 countries in 2010. Collectively, participating clinics in

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

these countries performed 133 679 fresh and frozen donor egg transfers: 36 291 in 2008; 48 093 in 2009; and 49 295 in 2010, representing a 35.8% increase from 2008 to 2010 (Supplementary data, Tables SXIa–SXIc). A relevant part of this increase was attributable to Spain where 10 882 transfers were conducted in 2009 compared with only 3880 transfers in 2008. In 2007, however, Spain reported 7881 transfers, thus making underreporting in 2008 possible which could have falsely inflated the overall increase between 2008 and 2010 (Ishihara *et al.*, 2015). Irrespectively, Spain recorded the second highest number of oocyte donation transfer cycles in the 3-year period ($n = 25\,981$), accounting for 48.7% of all donor transfer cycles in Europe and 19.4% of the world's total donor transfers in the triennium. These figures were exceeded only by the USA where 44 533 donor egg transfers were conducted in the same period, equaling 33.3% of global donor transfers.

Women over the age of 40 years represented 67.3% of recipients in 2008 and 62.2% in 2010 (Supplementary data, Tables SXIa–SXIc). The cumulative DR following egg donation and including both fresh and frozen transfers was, in chronological order, 37.9, 36.1 and 36.2%. A total of 66 769 babies were reported born following fresh and frozen egg donation transfer: 20 281 in 2008; 23 917 in 2009; and 22 571 in 2010. The rate of SET was 15.1 and 14.9% for 2008 and 2009, increasing to 19.5% in 2010. Regional variation in SET ranged from 4.7% (Latin America, 2010) to 70.6% (Australia/New Zealand, 2010). The global multiple DR was 31.8% in 2008; 30.3% in 2009; and 29.1% in 2010 (Supplementary data, Tables SXIa–SXIc).

Information on PGD was provided by 30 (2008), 28 (2009) and 31 countries (2010). Aspirations involving PGD increased by 28.2%: from 8673 in 2008 to 11 116 in 2010. The PGD DR per aspiration was 26.0% in 2008, 24.2% in 2009; and 24.4% in 2010; with a total of 8593 babies reported born: 2658 in 2008; 2776 in 2009; and 3159 in 2010 which corresponds to an 18.8% increase in babies born from 2008 to 2010 (Supplementary data, Tables SXIIa–SXIIc). Availability of *in vitro* maturation increased from 14 countries in 2008 to 29 countries in 2010. The practice of maternal surrogacy was reported from five (2008), six (2009) and seven countries (2010). On the other hand, 22, 31 and 25 countries indicated availability of fetal reduction in the 3-year period (Supplementary data, Tables SXa–SXc).

### Intrauterine insemination

Data on IUI with husband sperm (IUI-H) were provided, in chronological order, by 40, 39 and 37 countries, respectively. A total of 523 665 cycles were conducted: 157 154 in 2008; 172 988 in 2009; and 193 523 in 2010, representing a 23.1% increase between 2008 and 2010. No information on the use of ovarian stimulation was collected. The global PR/cycle remained relatively constant in the period of observation: 12.7% in 2008; 12.4% in 2009; and 12.1% in 2010 with DRs of 9.1, 8.7 and 8.8%. The rate of multiple deliveries fell from 11.3% in 2008 to 10.1% in 2010, but with a wide range among countries (Supplementary data, Tables SXIIIa–SXIIIc).

Thirty-five (2008), 33 (2009) and 34 (2010) countries reported 32 119; 33 255; and 43 138 cycles of IUI with donor sperm and a resultant DR of 12.6; 13.4; and 13.3%. The multiple DR was slightly lower when compared with IUI-H, namely 9.4% in 2008; 10.3% in 2009; and 8.3% in 2010 (Supplementary data, Tables SXIVa–SXIVc).

## Discussion

The ICMART World Collaborative Report on ART, 2008–2009–2010, is the 15th ICMART World Report on ART practice and is the most comprehensive global statistical report on the utilization, effectiveness, safety and quality of ART services. Continual monitoring of ART practice and outcomes at an international level is essential to quantify comparative levels of access to fertility services, determining effectiveness of treatment and identify safety issues. In recognition of the right to universal access to reproductive health (Millennium Development Goal 5B, Sustainable Development Goal 3.7) the ICMART World Reports are important documents at a global, regional and local level for informing policy development, clinical practice, education and advocacy.

In this study, as in previous reports, we have endeavored to standardize reporting to allow the reader to follow trends over time. This report provides annual tables and figures for 2008, 2009 and 2010, as well as summarizing the aggregate results for the 3-year period. A new electronic data collection system developed by ICMART in collaboration with the University of Uppsala will facilitate more contemporaneous global ART monitoring in the future.

Between 2008 and 2010, 4 461 309 cycles were initiated, resulting in the estimated birth of 1 144 858 babies. The estimated overall number of initiated cycles and of babies born increased by almost 9.5 and 9.1% per annum, respectively, during the 3-year period. The ongoing global expansion of ART can be attributed both to increased utilization within countries where ART is well established as well as the adoption of the technology into previously ART naïve countries.

### Reported utilization

Between 58 and 61 countries reported annually on the utilization and outcomes of ART during the period of observation. Just over 70% of ART clinics reported to exist in these countries submitted their data for this World Report, with complete participation reported from up to 28 countries and one region (Australia/New Zealand). Europe recorded consistently a >80% participation rate and North America over 75% participation rate; however, participation in the Middle East fell from 22.2 to 7.5% during the triennium.

Reported utilization could be considered an imperfect measure but is the best available metric we have to measure access. Based on reported utilization, access to treatment varied greatly among countries and regions. Israel had consistently the highest level of access with over 4000 cycles per million population, followed by Australia and New Zealand with almost 2500 cycles per million population and Europe with almost 900 cycles per million population. In contrast, utilization was around 150 cycles per million population in Latin America and just over half of that in sub-Saharan Africa (90 cycles per million population). Moreover, substantial disparities in access to ART treatment exist within regions, for example the Nordic countries exhibiting utilization rates around 2500 cycles per million while Eastern European countries had approximately one quarter of this utilization.

The overall global utilization of ART treatment was 448 cycles per million population in the 3-year period of observation. This conservatively represents <20% of the demand for ART treatment being met, based on an estimate from the European Society of Human Reproduction and Embryology, which estimated that 3000 couples per million population are eligible for ART—a number well in excess of utilization documented in this report (ESHRE Capri Workshop Group, 2001).

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

Access to ART treatment is dependent on socio-cultural and economic factors both at the individual and country level, with the cost of treatment borne by the patient playing a major role in who can afford to access treatment (Adamson, 2009; Dyer *et al.*, 2013; Chambers *et al.*, 2014). Such disparities are exemplified within high-income countries. The Nordic countries, Australia and Israel, which have supportive public or third-party reimbursement for ART treatment, have the highest levels of utilization, while the USA and Canada, which have restricted reimbursement arrangements, have one-fifth of the former countries utilization. Developing regions have substantially lower levels of utilization, ranging from one quarter (Latin America) to less than one-fifth (sub-Saharan Africa) of the utilization of North America. Such inequity of access to reproductive health services across the globe does not adequately support the health and welfare of women and their families, and challenges the basic human activity and right to create a family (Inhorn, 2009; Zegers-Hochschild *et al.*, 2013).

## ART practice

The rising trend of performing a high proportion of ICSI cycles appears to have leveled off, remaining relatively constant at around 66% of aspiration cycles during the triennium and in keeping with the same rate in 2006 (Mansour *et al.*, 2014). However, large disparities in the use of ICSI remain among regions with almost 100% of cycles in the Middle East involving ICSI, compared with 55% in Asia and 65% in Europe. The reasons behind the high use of ICSI in some regions are not fully understood and are outside of the scope of this report. ICSI was developed as a treatment for male factor infertility, a condition that affects ~40% of couples seeking ART, and the use ICSI for non-male factor infertility may require further justification (Centers for Disease Control and Prevention *et al.*, 2014; Macaldowie *et al.*, 2015). A Cochrane Review concluded that that there is little evidence that ICSI provides any benefit for couples undertaking ART where there is no evidence of male factor infertility (van Rumste *et al.*, 2004). Investigating why ICSI is a preferred fertilization technique in a number a countries, particularly in Latin America and the Middle East, is warranted.

The number and proportion of FET cycles performed globally continued to steadily increase from 21.5% of non-donor cycles in 2006 to 26.5% of all initiated autologous cycles in 2010. The shift to SET, which encourages the cryopreservation of supernumerary embryos, and the effectiveness of vitrification as a cryopreservation method is likely the reason for the increased use of FET cycles. Importantly, the rates of premature delivery and perinatal mortality were lower in FET cycles when compared with fresh embryo transfer cycles. These differences could be a reflection of the lower rate of multiple births in FET compared with fresh transfers; they could also be associated with a different patient population with better reproductive performance (that is able to create extra embryos for cryopreservation and have better pregnancy outcome) or differences in the quality of implantation between fresh and frozen embryos.

The number of oocyte donation cycles has steadily increased over the last decade to almost 50 000 cycles in 2010, representing over 6% of initiated cycles in 2010. However, there were marked differences among regions and countries. These differences relate to differences in national legislation and funding arrangements. Furthermore, for ethnocultural reasons, oocyte donation is not available in Japan, most countries in the Middle East and several countries in Europe such as Austria, Germany and Switzerland.

There was an almost 30% increase in the number PGD aspirations between 2008 and 2010 which is likely to reflect the uptake of preimplantation genetic screening (PGS) for aneuploidy using advanced diagnostic techniques, such as array comparative genomic hybridization which allows for comprehensive screening of all 24 chromosomes. PGS is being increasingly used on the premise of improving PRs in women of advanced maternal age and those with repeated implantation failure or miscarriage. Its overall clinical role, however, remains largely unknown with few randomized trials having been reported in a fertility clinic setting (Lee *et al.*, 2015).

## Effectiveness

There are a number of measures that can be used to express the effectiveness of ART treatment. With the increasing use of FET and the emphasis on a successful ART treatment outcome being a singleton infant, one approach is to combine the outcomes of FET cycles with the associated fresh cycle from which the embryos were obtained to obtain the cumulative DR. It is not possible to provide precise cumulative data on a global basis since most countries provide aggregate data to ICMART rather than individual level data. Despite this, cumulative data can be extrapolated as described previously (Zegers-Hochschild *et al.*, 2014). As expected, the cumulative DR has been steadily increasing from 25.2% in 2006 to 27.1% in 2010 (Mansour *et al.*, 2014). This is despite the fresh SET rate increasing from 20.7 to 30.0%, and the FET SET rate increasing from 29.1 to 51.2% over the same period. A variety of factors are likely responsible for this improvement, including improved laboratory and clinical practices, and potentially better prognosis patients accessing ART earlier in the infertility treatment pathway than in the past.

The need to move to reporting of cumulative live birth rates based on individual patient data, rather than DRs or live birth rates only, has recently been highlighted (Maheshwari *et al.*, 2015). The authors also drew attention to the associated difficulties generated by a current lack of consensus regarding suitable numerators, denominators and time spans. Reaching such consensus will be of importance in comparing effectiveness within and across registries in future. It is anticipated that the current revision and expansion of the ICMART/WHO Glossary will make a relevant contribution in this regard.

## Safety and quality

The most significant risk of ART treatment is multiple gestations due to the transfer of more than one embryo and the associated risks to both mother and baby (Practice Committee of the American Society for Reproductive Medicine, 2012; Sullivan *et al.*, 2012; ESHRE Capri Workshop Group, 2013). Plotting the average number of embryos transferred against the MBR and preterm birth rates (Fig. 1a–c) highlights the strong correlation between the number of embryos transferred and the risk of poor perinatal outcomes. As previously mentioned, the SET rate has increased substantially over recent years, while the proportion of fresh cycles transferring three embryos has decreased from 21.6% of cycles in 2006 to 16.7% of cycles in 2010. Similarly, the proportion of cycles transferring four or more embryos has decreased from 9 to 4% over the same period. Despite this improvement, the proportion of fresh cycles transferring two embryos has remained stable at 49% of cycles. Given the high risk of twins following DET, transferring more than one embryo should be reserved for poorer prognosis patients

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

(Pandian et al., 2013). This safety precaution should be taken despite the positive correlation that was found between the mean number of embryos transferred and the DR when the 2008–2009–2010 data were pooled, since firstly the statistical significance of the finding is based on large populations and secondly any small increase in DR is offset by the high risk of multiple pregnancies and its many complications. In line with the reduction in average number of embryos transferred, the global MBR has decreased for fresh cycles (23.7–21.5%) and FET cycles (17.2–12%) between 2006 and 2010. However, the number of embryos transferred and thus multiple births rates varied considerably among countries and regions, resulting in wide differences in ART MBRs across the globe. In 2010, only Sweden, Australia, New Zealand and Japan reported fresh cycle MBRs of $<10\%$.

The number of embryos transferred has been shown to be associated with the cost that patients pay for ART treatment, with less affordable treatment creating a financial incentive to transfer more embryos in the hope of achieving a pregnancy in a limited number of costly ART cycles (Hamilton and McManus, 2012; Chambers et al., 2014). Multiple pregnancy and births not only result in poorer outcomes for mothers and babies but in greater long-term costs associated with caring for complicated pregnancies and preterm birth—a cost and responsibility that in better resourced countries is commonly carried by society through government health plans (ESHRE Capri Workshop Group, 2013); and in less well-resourced countries creates major financial burdens for affected patients and their households. This provides a strong argument for providing supportive public or third-party insurance for ART treatment.

### Limitations and strengths

The data presented are dependent on the quality and completeness of data submitted by individual countries. Although possible data errors and inconsistencies are queried with country representatives, no further validation of the data occurs as this is not feasible. The quality and completeness of the data in turn reflect local data collection practices, and thus varies by individual region and country. The quality of the data is largely dependent on the local regulatory environment and whether data supply at a national level is mandatory or voluntary. This report covers approximately two-thirds of the world ART activity. Although not complete, it is the most comprehensive report on ART activity and practice. ICMART continues to work at an international level to obtain information from countries that have started to collect ART data, including China which is estimated to represent a significant proportion of the missing data. Furthermore, ICMART, as a non-governmental organization (NGO) in official relations with the WHO, works at global, regional and national levels to facilitate data collection. This includes providing the ICMART/WHO Glossary on ART Terminology to facilitate the use of standard data definitions globally, and publishing a 'toolkit' to support countries setting up registries to monitor ART (Zegers-Hochschild et al., 2009). As part of its mandate as an NGO in official relationship with WHO, strong efforts are undertaken in order to facilitate the establishment of national and regional ART registries. To this effect, ICMART obtained the first data from sub-Saharan Africa in 2009 making this the first world report presenting data from all regions of the world. Specifically, ICMART played an important role in assisting sub-Saharan African countries to collect their data and to establish a national registry in South Africa (Dyer and Kruger, 2012). This capacity building is currently expanding to help role players and countries to form a regional ART registry in sub-Saharan Africa involving both Anglophone and Francophone countries.

## Conclusion

For a quarter century, the ICMART World Reports have provided the most comprehensive global statistical census and review of ART utilization, effectiveness, safety and quality. The continued increase in ART use globally was again reported for the period 2008–2009–2010, with wide disparities in access to treatment among regions and countries. The continued trend to SET is to be encouraged. The MBR in most countries remains unacceptably high and should be the focus of continued policy and practice improvement. The growing body of evidence that affordable ART treatment reduces disparities in access to treatment while incentivizing safe embryo transfer practices calls for policies that support public or third-party funding across the globe. ICMART continues to support the countries and regions in the collection of data and is making significant progress in improving the data ascertainment for countries that have previously not reported.

## Supplementary data

Supplementary data are available at http://humrep.oxfordjournals.org/.

## Acknowledgements

The authors gratefully acknowledge all individuals as well as national and regional organizations and registries, including the American Society for Reproductive Medicine (ASRM), Australian and New Zealand Assisted Reproduction Database (ANZARD), European Society for Human Reproduction and Embryology (ESHRE), European IVF Monitoring Consortium (EIM), Fertility Society of Australia (FSA), Japan Society of Obstetrics and Gynecology (JSOG), Japan Society for Reproductive Medicine (JSRM), Latin American Network for Reproductive Medicine (REDLARA), Middle East Fertility Society (MEFS), Society for Assisted Reproductive Technology (SART) and Southern African Society of Reproductive Medicine and Gynaecological Endoscopy (SASREG) for the submission of data to ICMART. We thank N. Hadziosmanovic at Uppsala University for his statistical support.

## Authors' roles

All authors contributed to study design, collection and interpretation of the data and the overall conduct of the study. S.D., G.M.C., G.D.A. prepared the manuscript and all authors were involved in the revision. The final manuscript and order of authorship has been approved by all authors.

## Funding

ICMART acknowledges financial support from the following organizations: American Society for Reproductive Medicine; European Society for Human Reproduction and Embryology; Fertility Society of Australia; Japan Society for Reproductive Medicine; Japan Society of Fertilization and Implantation; Red Latinoamericana de Reproduccion Asistida; Society for Assisted Reproductive Technology; Government of Canada (Research grant), Ferring Pharmaceuticals (survey grant support not related to world reports).

Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016

## Conflict of interest

G.D.A. discloses the following relationships: Founder and Chief Medical Officer of Advanced Reproductive Care, Inc.; Consultant to AbbVie, Bayer, Ferring, Ziva.

## References


Adamson GD. Global cultural and socioeconomic factors that influence access to assisted reproductive technologies. *Womens Health* 2009; **5**:351–358.

Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology. 2012 Assisted Reproductive Technology Fertility Clinic Success Rates Report. Atlanta, GA: US Dept of Health and Human Services, 2014.

Chambers GM, Hoang VP, Sullivan EA, Chapman MG, Ishihara O, Zegers-Hochschild F, Nygren KG, Adamson GD. The impact of consumer affordability on access to assisted reproductive technologies and embryo transfer practices: an international analysis. *Fertil Steril* 2014; **101**:191–198.e194.

Dyer SJ, Kruger TF. Assisted reproductive technology in South Africa: first results generated from the South African Register of Assisted Reproductive Techniques. *South Afr Med J* 2012;**102**:167–170.

Dyer SJ, Sherwood K, McIntyre D, Ataguba JE. Catastrophic payment for assisted reproduction techniques with conventional ovarian stimulation in the public health sector of South Africa: frequency and coping strategies. *Hum Reprod* 2013;**28**:2755–2764.

ESHRE Capri Workshop Group. Social determinants of human reproduction. *Hum Reprod* 2001;**16**:1518–1526.

ESHRE Capri Workshop Group. Failures (with some successes) of assisted reproduction and gamete donation programs. *Hum Reprod Update* 2013; **19**:354–365.

Hamilton BH, McManus B. The effects of insurance mandates on choices and outcomes in infertility treatment markets. *Health Econ* 2012; **21**:994–1016.

Inhorn MC. Right to assisted reproductive technology: overcoming infertility in low-resource countries. *Int J Gynaecol Obstet* 2009;**106**:172–174.

Ishihara O, Adamson GD, Dyer S, de Mouzon J, Nygren KG, Sullivan EA, Zegers-Hochschild F, Mansour R. International Committee for Monitoring Assisted Reproductive Technologies: world report on assisted reproductive technologies, 2007. *Fertil Steril* 2015;**103**: 402–413.e11.

Lancaster PA. Registers of in-vitro fertilization and assisted conception. *Hum Reprod* 1996;**11**(Suppl 4):89–104.

Lee E, Illingworth P, Wilton L, Chambers GM. The clinical effectiveness of preimplantation genetic diagnosis for aneuploidy in all 24 chromosomes (PGD-A): systematic review. *Hum Reprod* 2015;**30**:473–483.

Macaldowie A, Lee E, Chambers GM. Assisted reproduction technology in Australia and New Zealand 2013. Assisted reproduction technology series no. 18. Sydney: The University of New South Wales, 2015.

Maheshwari A, McLernon D, Bhattacharya S. Cumulative live birth rate: time for a consensus? *Hum Reprod* 2015;**30**:2703–2707.

Mansour R, Ishihara O, Adamson GD, Dyer S, de Mouzon J, Nygren KG, Sullivan E, Zegers-Hochschild F. International Committee for Monitoring Assisted Reproductive Technologies world report: assisted reproductive technology 2006. *Hum Reprod* 2014;**29**:1536–1551.

Pandian Z, Marjoribanks J, Ozturk O, Serour G, Bhattacharya S. Number of embryos for transfer following in vitro fertilisation or intra-cytoplasmic sperm injection. *Cochrane Database Syst Rev* 2013;**7**:CD003416. doi: 10.1002/14651858.CD003416.pub4.

Practice Committee of the American Society for Reproductive Medicine. Multiple gestation associated with infertility therapy. *Fertil Steril* 2012; **97**:825–834.

Sullivan EA, Wang YA, Hayward I, Chambers GM, Illingworth P, McBain J, Norman RJ. Single embryo transfer reduces the risk of perinatal mortality, a population study. *Hum Reprod* 2012;**27**:3609–3615.

van Rumste MM, Evers JL, Farquhar CM. ICSI versus conventional techniques for oocyte insemination during IVF in patients with non-male factor subfertility: a Cochrane review. *Hum Reprod* 2004;**19**:223–227.

Zegers-Hochschild F, Adamson GD, de Mouzon J, Ishihara O, Mansour R, Nygren K, Sullivan E, van der Poel S, on behalf of ICMART and WHO. The International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary on ART terminology, 2009. *Hum Reprod* 2009;**24**: 2683–2687.

Zegers-Hochschild F, Dickens BM, Dughman-Manzur S. Human rights to in vitro fertilization. *Int J Gynaecol Obstet* 2013;**123**:86–89.

Zegers-Hochschild F, Mansour R, Ishihara O, Adamson GD, de Mouzon J, Nygren KG, Sullivan EA. International Committee for Monitoring Assisted Reproductive Technology: world report on assisted reproductive technology, 2005. *Fertil Steril* 2014;**101**:366–378.


Downloaded from http://humrep.oxfordjournals.org/ by guest on September 23, 2016