

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

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**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.

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**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.

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**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](http://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 SI–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 Sla–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 Sla–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

**Table 1a** Reported data and ICMART estimations (bold) for year 2008.

Country name	Fresh IVF and ICSI			FET							
	Aspirations <sup>a</sup>	PR/ Asp <sup>b</sup> (%)	DR/ Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h,j</sup> babies reported from participating clinics	Total <sup>h,j</sup> babies estimated from all clinics
India	<b>15 687</b>	NA	NA	NA	<b>29.0</b>	<b>32.8</b>	33.5	<b>90 870</b>	<b>79</b>	6484	<b>26 738</b>
Japan	125 727	11.0	6.9	16.3	7.4	17.3	21.5	<b>19 1115</b>	<b>1501</b>	21 794	<b>22 011</b>
South Korea	20 901	30.2	<b>20.8</b>	<b>26.6</b>	NA	NA	13.1	<b>51 353</b>	<b>1043</b>	<b>7216</b>	<b>13 322</b>
Australia <sup>a</sup>	30 740	25.0	19.5	29.8	21.2	32.6	19.8	55 269	2683	10 531	10 531
New Zealand <sup>a</sup>	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	<b>652</b>	<b>180</b>	68	<b>272</b>
Austria <sup>a</sup>	5320	33.4	<b>23.1</b>	<b>25.0</b>	NA	NA	NA	6576	801	<b>1724</b>	<b>1724</b>
Belgium	16 840	27.3	19.2	25.5	21.5	29.4	20.2	28 576	2747	5084	5084
Bosnia and Herzegovina <sup>a</sup>	167	33.5	18.0	18.0	19.2	19.2	NA	<b>900</b>	<b>196</b>	32	<b>160</b>
Bulgaria	2891	34.9	29.2	30.0	37.9	38.7	15.2	<b>5603</b>	<b>771</b>	1158	<b>1969</b>
Czech Republic <sup>a</sup>	11 788	32.4	<b>22.3</b>	<b>26.1</b>	NA	NA	NA	17 569	1719	<b>3984</b>	<b>3984</b>
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	<b>77 452</b>	<b>1209</b>	14 369	<b>15 087</b>
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	<b>20 408</b>	<b>1903</b>	457	<b>3808</b>
Hungary	2431	36.1	29.1	33.8	35.8	41.4	25.8	<b>5458</b>	<b>550</b>	1020	<b>1749</b>
Iceland	411	21.9	19.7	32.8	21.9	37.7	29.5	<b>720</b>	<b>2366</b>	178	178
Ireland	2428	29.9	25.5	29.2	31.3	35.6	18.5	<b>4882</b>	<b>1175</b>	873	<b>1222</b>
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	<b>9114</b>	<b>594</b>	513	<b>3078</b>
Latvia	176	39.2	<b>27.3</b>	<b>33.5</b>	NA	NA	NA	<b>1348</b>	<b>600</b>	<b>77</b>	<b>308</b>
Lithuania	421	27.6	4.0	4.5	5.7	6.2	4.8	<b>1000</b>	<b>280</b>	26	<b>52</b>
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	<b>26.7</b>	<b>33.0</b>	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

Romania	954	29.9	4.8	5.5	NA	NA	NA	<b>3324</b>	<b>149</b>	67	<b>201</b>
Russia	24 466	33.3	22.6	24.9	28.1	31.4	24.9	<b>41 445</b>	<b>295</b>	8422	<b>11 363</b>
Serbia	1503	28.5	22.3	22.3	25.7	25.7	NA	<b>3148</b>	<b>310</b>	390	<b>780</b>
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	<b>76 529</b>	<b>1890</b>	9089	<b>18 380</b>
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	<b>8816</b>	<b>1163</b>	1625	<b>1690</b>
Turkey	43 928	36.2	NA	NA	51.8	51.8	NA	<b>47 432</b>	<b>660</b>	22 764	22 764
Ukraine	5608	35.9	28.5	32.6	36.5	41.7	28.6	<b>10 985</b>	<b>239</b>	2620	<b>3930</b>
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	<b>18 303</b>	<b>450</b>	2256	<b>4615</b>
Bolivia	48	10.4	10.4	10.4	14.6	14.6	0.0	<b>246</b>	<b>27</b>	7	<b>21</b>
Brazil	11 434	33.2	26.1	29.3	35.8	39.7	21.4	<b>28 505</b>	<b>149</b>	5154	<b>9042</b>
Chile	1258	35.9	30.4	34.1	38.5	42.7	18.3	<b>2061</b>	<b>125</b>	592	<b>666</b>
Colombia	988	31.6	21.3	22.6	26.7	28.7	23.0	<b>2016</b>	<b>45</b>	422	<b>591</b>
Ecuador	262	34.4	7.3	8.4	10.3	11.5	23.1	<b>831</b>	<b>60</b>	110	<b>193</b>
Guatemala	56	37.5	21.4	21.4	28.6	28.6	0.0	<b>156</b>	<b>12</b>	26	<b>52</b>
Mexico	2766	31.7	26.0	28.5	32.8	35.8	22.0	<b>13 836</b>	<b>126</b>	1371	<b>4640</b>
Peru	805	27.3	22.0	22.7	27.3	28.1	7.0	<b>4549</b>	<b>156</b>	591	<b>1576</b>
Uruguay	219	29.2	25.6	27.4	33.3	35.6	12.8	<b>501</b>	<b>144</b>	88	<b>132</b>
Venezuela	729	33.7	25.7	29.1	32.2	36.4	29.1	<b>1728</b>	<b>65</b>	394	<b>525</b>
Egypt	10 311	36.8	NA	NA	42.7	45.5	23.4	<b>57 024</b>	<b>698</b>	4699	<b>21 146</b>
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	<b>175</b>	NA
Israel <sup>a</sup>	<b>22 775</b>	<b>25.2</b>	<b>17.4</b>	<b>22.4</b>	NA	NA	NA	29 196	4105	<b>6607</b>	<b>6607</b>
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	<b>17 9284</b>	<b>590</b>	59 912	<b>78 832</b>

Region	Fresh IVF and ICSI							FET				
	Aspirations <sup>a</sup>	PR/Asp <sup>b</sup> (%)	DR/Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h, j</sup> babies reported from participating clinics	Total <sup>i, j</sup> 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

Table 1a Continued

Country name	Fresh IVF and ICSI						FET					
	Aspirations <sup>a</sup>	PR/ Asp <sup>b</sup> (%)	DR/ Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h,i</sup> babies reported from participating clinics	Total <sup>h,i</sup> babies estimated from all clinics	
Middle East	11 455	36.4	33.8	39.0	41.2	44.1	23.1	>57 024	698	5 134	>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).

<sup>a-i</sup>Imputed/estimated data printed in bold.

<sup>a</sup>Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.

<sup>b</sup>Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.

<sup>c</sup>Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.

<sup>d</sup>Imputed by calculating the mean percentage of deliveries per pregnancy.

<sup>e</sup>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.

<sup>f</sup>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.

<sup>g</sup>Total estimated number of cycles in the country divided by its population in 2008 (CIA World Fact Book).

<sup>h</sup>Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.

<sup>i</sup>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.

<sup>j</sup>Total babies also includes PGD and oocyte donation (OD).

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

Country name	Fresh IVF and ICSI				FET						
	Aspirations <sup>a</sup>	PR/ Asp <sup>b</sup> (%)	DR/ Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h, j</sup> babies reported from participating clinics	Total <sup>h, j</sup> babies estimated from all clinics
India <sup>a</sup>	19 626	40.0	<b>29.1</b>	<b>32.6</b>	43.5	48.7	33.1	<b>92 616</b>	<b>79</b>	11 426	<b>38 371</b>
Indonesia	<b>764</b>	<b>33.2</b>	NA	NA	NA	NA	NA	<b>1902</b>	<b>8</b>	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	<b>21.2</b>	<b>27.8</b>	NA	NA	14.6	<b>63 670</b>	NA	<b>7202</b>	<b>16 605</b>
Australia <sup>a</sup>	35 875	25.1	19.4	29.4	21.2	32.2	20.1	63 191	2972	12 057	12 057
New Zealand <sup>a</sup>	2895	34.7	26.8	38.8	28.9	41.8	24.0	5118	1215	1279	1279
Austria	5766	31.8	<b>23.2</b>	<b>24.9</b>	NA	NA	NA	<b>6665</b>	<b>812</b>	<b>1780</b>	<b>1780</b>
Belgium	17 802	26.1	18.4	24.1	20.6	27.6	19.1	<b>28 872</b>	<b>2772</b>	5123	5123
Bulgaria	1579	30.1	26.3	27.2	31.0	32.2	18.0	<b>4369</b>	<b>606</b>	548	<b>1331</b>
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 <sup>a</sup>	11 706	26.9	<b>19.6</b>	<b>24.7</b>	NA	NA	NA	19 506	1910	<b>3590</b>	<b>3590</b>
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	<b>78 667</b>	<b>1228</b>	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	<b>4088</b>
Hungary	6215	30.3	<b>22.1</b>	<b>23.7</b>	NA	NA	NA	7111	718	<b>1833</b>	<b>1833</b>
Iceland	463	23.1	19.2	28.5	22.0	32.2	22.7	<b>806</b>	<b>2628</b>	169	169
Ireland	2736	28.2	22.9	27.1	28.3	32.8	18.7	<b>4740</b>	<b>1128</b>	898	<b>1048</b>
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	<b>7125</b>	<b>463</b>	513	<b>2565</b>
Latvia	491	35.8	<b>26.1</b>	<b>34.6</b>	NA	NA	NA	<b>1015</b>	<b>455</b>	<b>211</b>	<b>281</b>
Lithuania	115	39.1	26.1	27.8	38.3	40.0	16.7	<b>556</b>	<b>156</b>	46	<b>184</b>
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

Table 1b Continued

Country name	Fresh IVF and ICSI						FET				
	Aspirations <sup>a</sup>	PR/Asp <sup>b</sup> (%)	DR/Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h,j</sup> babies reported from participating clinics	Total <sup>i,j</sup> 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	<b>26.9</b>	<b>33.1</b>	28.5	39.4	25.9	<b>14 936</b>	<b>388</b>	3190	<b>3956</b>
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	<b>1578</b>	<b>71</b>	87	<b>131</b>
Russia	31 661	34.0	19.9	22.0	25.4	29.4	24.8	<b>57 056</b>	<b>407</b>	10 172	<b>14 213</b>
Serbia	1180	34.7	27.9	27.9	40.1	40.1	NA	<b>1643</b>	<b>223</b>	473	<b>631</b>
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	<b>81 808</b>	<b>2019</b>	12 351	<b>18 810</b>
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	<b>9463</b>	<b>1244</b>	1686	<b>1753</b>
Ukraine	5768	36.0	28.9	33.7	37.0	43.5	30.4	<b>11 308</b>	<b>247</b>	2889	<b>4045</b>
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	<b>22 282</b>	NA	2567	<b>5717</b>
Bolivia	69	11.6	11.6	14.5	11.6	15.9	33.3	<b>306</b>	<b>31</b>	14	<b>42</b>
Brazil	11 320	31.9	25.6	29.8	32.8	37.9	24.8	<b>30 363</b>	<b>153</b>	4897	<b>9069</b>
Chile	1273	30.2	24.5	29.1	31.3	37.2	27.5	<b>2521</b>	<b>152</b>	574	<b>738</b>
Colombia	972	28.3	22.8	26.2	29.9	34.0	30.2	<b>1686</b>	<b>37</b>	486	<b>535</b>
Ecuador	232	28.9	22.8	29.3	25.4	33.2	35.3	<b>866</b>	<b>59</b>	122	<b>244</b>
Guatemala	82	39.0	29.3	31.7	32.9	36.6	50.0	<b>196</b>	<b>15</b>	36	<b>72</b>
Mexico	2973	31.8	25.9	29.3	34.1	38.2	28.3	<b>16 819</b>	<b>151</b>	1639	<b>5769</b>
Peru	873	26.9	20.3	21.9	25.5	27.3	17.0	<b>4947</b>	<b>167</b>	563	<b>1501</b>
Uruguay	276	33.3	25.7	30.4	29.3	34.1	19.7	<b>632</b>	<b>181</b>	120	<b>180</b>
Venezuela	1079	29.7	23.6	26.3	28.6	31.4	22.9	<b>2051</b>	<b>76</b>	463	<b>540</b>
Egypt	7824	34.1	29.2	32.0	37.1	40.3	21.2	<b>73 320</b>	<b>882</b>	3157	<b>23 678</b>
Lebanon	847	25.9	17.0	17.1	24.8	24.8	NA	<b>11 780</b>	<b>2932</b>	265	<b>2650</b>
Palestinian Territory	174	33.9	31.6	31.6	54.6	54.6	NA	<b>1770</b>	<b>441</b>	95	<b>950</b>

Tunisia	2797	34.1	28.5	33.1	33.7	39.1	26.4	<b>13 556</b>	<b>1293</b>	1094	<b>4376</b>
Israel <sup>a</sup>	<b>25 687</b>	<b>23.7</b>	<b>17.3</b>	<b>21.9</b>	NA	NA	NA	31 978	4421	<b>7005</b>	<b>7005</b>
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	<b>178 572</b>	<b>581</b>	60 241	<b>79 446</b>
Cameroon	107	23.4	12.1	13.1	14.0	15.0	20.0	<b>288</b>	<b>15</b>	16	<b>32</b>
South Africa	3305	29.5	<b>21.5</b>	<b>21.5</b>	NA	NA	NA	<b>6172</b>	<b>126</b>	<b>882</b>	<b>1544</b>
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).

<sup>a</sup>—Imputed/estimated data printed in bold.

<sup>a</sup>Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.

<sup>b</sup>Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.

<sup>c</sup>Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.

<sup>d</sup>Imputed by calculating the mean percentage of deliveries per pregnancy.

<sup>e</sup>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.

<sup>f</sup>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.

<sup>g</sup>Total estimated number of cycles in the country divided by its population in 2009 (CIA World Fact Book).

<sup>h</sup>Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.

<sup>i</sup>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.

<sup>j</sup>Total babies also includes PGD and oocyte donation (OD).



**Table 1c** Reported data and ICMART estimations (bold) for year 2010.

Country name	Fresh IVF and ICSI				FET						
	Aspirations <sup>a</sup>	PR/Asp <sup>b</sup> (%)	DR/Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h,j</sup> babies reported from participating clinics	Total <sup>i,j</sup> babies estimated from all clinics
India	<b>21 779</b>	<b>30.6</b>	NA	NA	<b>34.0</b>	<b>40.0</b>	44.5	<b>118 670</b>	<b>103</b>	10 410	<b>41 092</b>
Indonesia <sup>a</sup>	1814	37.2	<b>27.8</b>	<b>27.8</b>	NA	NA	NA	<b>3732</b>	<b>16</b>	<b>618</b>	<b>1180</b>
Japan	153 729	9.3	6.2	18.1	6.5	19.9	25.3	<b>242 833</b>	<b>1911</b>	30 556	<b>30 764</b>
South Korea	23 202	29.7	<b>22.2</b>	<b>29.8</b>	NA	NA	18.5	<b>68 805</b>	NA	73	<b>155</b>
Taiwan	<b>8162</b>	<b>47.9</b>	<b>35.8</b>	<b>35.8</b>	NA	NA	NA	12 428	541	NA	NA
Australia <sup>a</sup>	30 335	26.0	19.9	31.6	21.6	34.5	21.9	54 465	2562	10 908	10 908
New Zealand <sup>a</sup>	2850	33.6	26.2	39.3	28.6	42.2	25.1	5069	1203	1280	1280
Austria	5782	34.5	<b>25.8</b>	<b>27.7</b>	27.0	NA	NA	6781	826	<b>1967</b>	<b>1967</b>
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	<b>15 120</b>	<b>2099</b>	1595	<b>4785</b>
Czech Republic <sup>a</sup>	11 985	50.2	24.8	31.1	NA	NA	NA	20 102	1968	<b>5359</b>	<b>5359</b>
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	<b>85 122</b>	<b>1329</b>	16 534	<b>17 011</b>
Germany	44 695	27.7	19.1	23.9	27.0	32.6	14.9	<b>75 701</b>	<b>919</b>	14 568	<b>15 846</b>
Greece	2413	31.9	24.9	29.0	33.1	38.7	30.8	<b>20 472</b>	<b>1907</b>	1116	<b>6200</b>
Hungary	5074	30.8	<b>23.0</b>	<b>24.3</b>	NA	NA	NA	5579	563	<b>1514</b>	<b>1514</b>
Iceland	502	29.1	24.3	34.1	27.7	38.4	27.0	<b>845</b>	<b>2755</b>	216	216
Ireland	2656	31.9	25.8	30.4	31.1	36.3	20.3	<b>4758</b>	<b>1132</b>	971	<b>1133</b>
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	<b>7460</b>	<b>484</b>	718	<b>2393</b>
Lithuania	110	30.0	<b>22.7</b>	<b>27.3</b>	NA	NA	NA	<b>524</b>	<b>147</b>	<b>37</b>	<b>148</b>
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	<b>1248</b>	<b>289</b>	242	<b>484</b>
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	<b>17 434</b>	<b>453</b>	3500	<b>4586</b>
Portugal	5427	32.2	24.8	27.4	30.6	33.5	20.5	7197	672	1985	1985
Romania	858	44.3	<b>33.1</b>	<b>37.3</b>	NA	NA	NA	<b>1496</b>	<b>67</b>	<b>393</b>	<b>511</b>
Russia	26 325	34.0	24.5	26.7	30.5	33.1	19.4	<b>54 219</b>	<b>387</b>	9640	<b>15 531</b>

Serbia	1460	34.3	26.5	26.5	33.2	33.2	NA	<b>2078</b>	<b>282</b>	484	<b>678</b>
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	<b>85 749</b>	<b>2116</b>	13 394	<b>20 806</b>
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	<b>9922</b>	<b>1305</b>	1733	<b>1802</b>
Ukraine	5122	37.3	29.2	34.1	36.8	42.7	25.6	<b>12 199</b>	<b>267</b>	2457	<b>4232</b>
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	<b>18 907</b>	<b>462</b>	2219	<b>4942</b>
Brazil	12 881	29.3	22.7	26.5	28.8	33.6	24.4	<b>32 377</b>	<b>163</b>	4966	<b>8868</b>
Chile	1198	27.0	21.0	24.8	26.1	31.0	22.7	<b>2165</b>	<b>130</b>	439	<b>564</b>
Colombia	716	28.6	21.9	26.7	28.5	34.2	32.3	<b>1664</b>	<b>38</b>	400	<b>550</b>
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	<b>797</b>	<b>55</b>	164	<b>262</b>
Guatemala	84	27.4	21.4	23.8	42.9	46.4	25.0	<b>228</b>	<b>17</b>	48	<b>96</b>
Mexico	2761	34.9	25.7	31.1	33.6	40.3	29.0	<b>15 784</b>	<b>142</b>	1682	<b>5921</b>
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	<b>4488</b>	<b>152</b>	798	<b>1596</b>
Uruguay	233	34.3	22.7	25.8	27.5	33.9	32.6	<b>537</b>	<b>154</b>	106	<b>159</b>
Venezuela	612	37.6	29.4	34.8	35.9	42.0	30.3	<b>1287</b>	<b>48</b>	459	<b>536</b>
Egypt	6803	36.2	25.7	28.3	34.2	38.1	16.8	<b>132 820</b>	<b>1684</b>	2613	<b>40 502</b>
Lebanon	1078	21.8	NA	NA	NA	NA	NA	<b>13 350</b>	<b>3323</b>	75	<b>750</b>
Tunisia	1674	30.4	24.2	27.8	30.8	35.4	26.0	<b>16 336</b>	<b>1558</b>	592	<b>4736</b>
Israel <sup>a</sup>	<b>27 911</b>	<b>23.1</b>	<b>17.3</b>	<b>21.5</b>	NA	NA	NA	34 538	4775	<b>7372</b>	<b>7372</b>
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	<b>176 214</b>	<b>574</b>	59 476	<b>76 194</b>
Cameroon	96	20.8	20.8	20.8	NA	NA	NA	<b>218</b>	<b>12</b>	1	<b>2</b>
Mali <sup>a</sup>	171	24.0	<b>18.1</b>	<b>18.1</b>	NA	NA	NA	<b>184</b>	<b>14</b>	<b>38</b>	<b>38</b>
South Africa	4352	31.8	<b>23.8</b>	<b>23.8</b>	NA	NA	NA	<b>6701</b>	<b>137</b>	<b>1269</b>	<b>1813</b>
<b>Region</b>	<b>Fresh IVF and ICSI Aspirations<sup>a</sup></b>	<b>PR/Asp<sup>b</sup> (%)</b>	<b>DR/Asp<sup>c</sup> (%)</b>	<b>DR/Asp<sup>d</sup> Cumul. (%)</b>	<b>Babies<sup>e</sup> /Asp fresh (%)</b>	<b>Babies<sup>e</sup> /Asp Cumul. (%)</b>	<b>Babies<sup>e</sup> /FET (%)</b>	<b>Estimated<sup>f</sup> or reported overall total number of cycles</b>	<b>Availability<sup>g</sup> cycles/million</b>	<b>Total<sup>h,i</sup> babies reported from participating clinics</b>	<b>Total<sup>h,i</sup> babies estimated from all clinics</b>
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

Table 1c Continued

Country name	Fresh IVF and ICSI						FET				
	Aspirations <sup>a</sup>	PR/ Asp <sup>b</sup> (%)	DR/ Asp <sup>c</sup> (%)	DR/Asp <sup>d</sup> Cumul. (%)	Babies <sup>e</sup> /Asp fresh (%)	Babies <sup>e</sup> /Asp Cumul. (%)	Babies <sup>e</sup> /FET (%)	Estimated <sup>f</sup> or reported overall total number of cycles	Availability <sup>g</sup> cycles/million	Total <sup>h,i</sup> babies reported from participating clinics	Total <sup>h,i</sup> 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).

<sup>a</sup>Imputed/estimated data printed in bold.

<sup>b</sup>Imputed by applying the average cancellation rate to the number of initiated cycles when not reported.

<sup>c</sup>Imputed by calculating the number of aspirations from the number of initiated cycles reported when not reported.

<sup>d</sup>Imputed by calculating the mean percentage of deliveries per pregnancy when not reported.

<sup>e</sup>Imputed by calculating the mean percentage of deliveries per pregnancy.

<sup>f</sup>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.

<sup>g</sup>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.

<sup>h</sup>Total estimated number of cycles in the country divided by its population in 2010 (CIA World Fact Book).

<sup>i</sup>Imputed by multiplying number of deliveries by the average number of babies per delivery category described in form 4.

<sup>j</sup>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.

<sup>k</sup>Total babies also includes PGD and oocyte donation (OD).

**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 <sup>a</sup>	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

Table IIa Continued

Country name	Aspirations	Transfers	Number of transferred embryos (%)					Multiple births	
			1	2	3	≥4	Average <sup>a</sup>	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 <sup>a</sup>	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.

<sup>a</sup>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).

**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 <sup>a</sup>	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

Table IIb Continued

Country name	Aspirations	Transfers	Number of transferred embryos (%)					Multiple births	
			1	2	3	≥4	Average <sup>a</sup>	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 <sup>a</sup>	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.

<sup>a</sup>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.

**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 <sup>a</sup>	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



**Table 11c** *Continued*

Country name	Aspirations	Transfers	Number of transferred embryos (%)					Multiple births	
			1	2	3	≥4	Average <sup>a</sup>	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 <sup>a</sup>	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.

<sup>a</sup>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'.

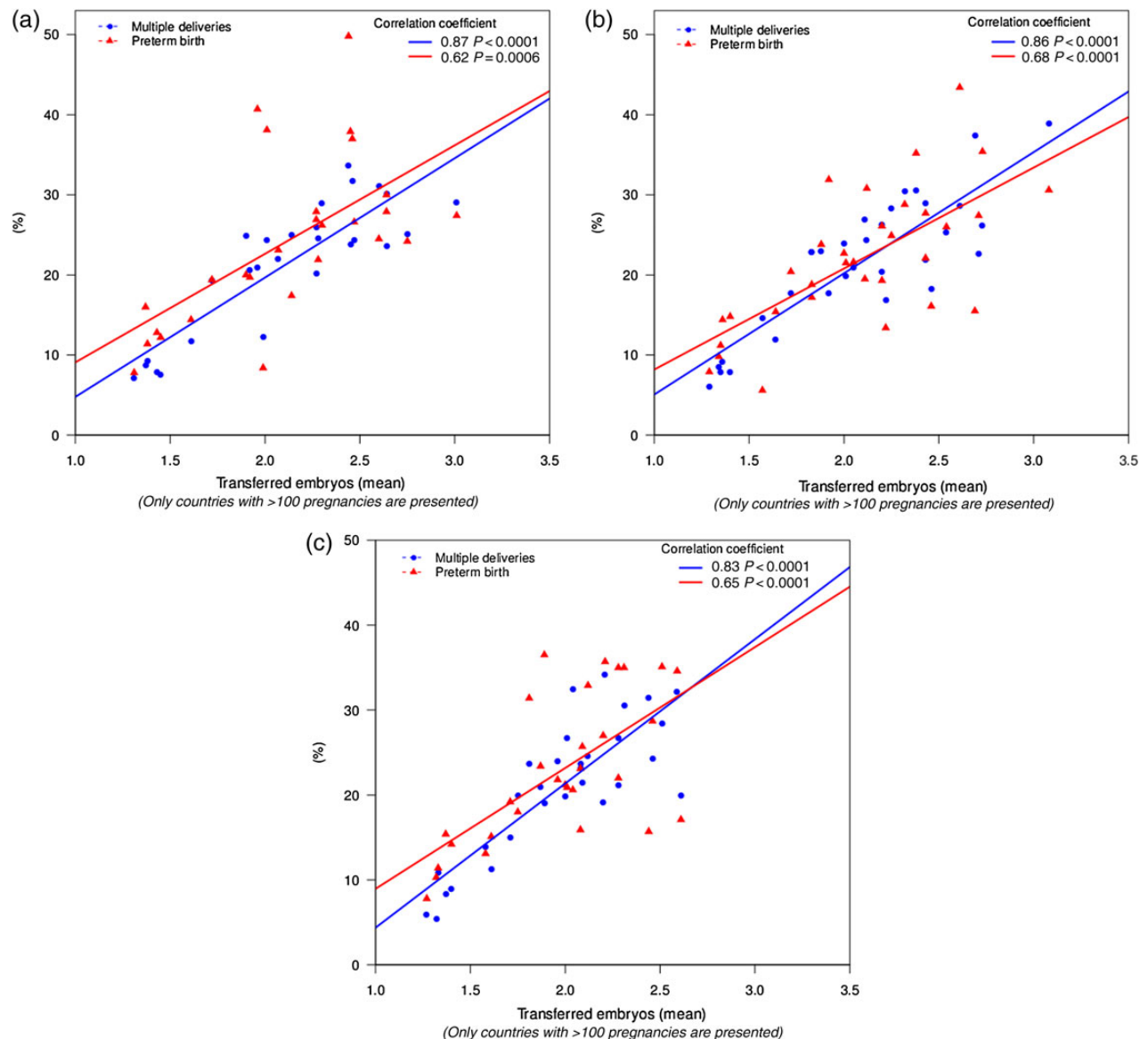
The average number of embryos transferred in fresh non-donor IVF and ICSI cycles fell from 2.1 (2008) to 1.9 (2010) (country range 1.3 [Sweden; 2010] to 3.6 [Palestinian Territory; 2009]) (Tables 11a–11c; [Supplementary data, Fig. S1a–c](#)). Three regions were consistently below the annual average (Australia/New 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



**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

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).

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 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 ethno-cultural 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

(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/>.

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## 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.

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## 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.

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