ORIGINAL ARTICLE: ASSISTED REPRODUCTION

International Committee for Monitoring Assisted Reproductive Technologies (ICMART): world report on assisted reproductive technologies, 2013

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Objective: To report the utilization, effectiveness, and safety of practices in assisted reproductive technology (ART) globally in 2013 and assess global trends over time.
Design: Retrospective, cross-sectional survey on the utilization, effectiveness, and safety of ART procedures performed globally during 2013.
Setting: Seventy-five countries and 2,639 ART clinics.
Patient(s): Women and men undergoing ART procedures.
Intervention(s): All ART.
Main Outcome Measure(s): The ART cycles and outcomes on country-by-country, regional, and global levels. Aggregate country data were processed and analyzed based on methods developed by the International Committee for Monitoring Assisted Reproductive Technology (ICMART).
Result(s): A total of 1,858,500 ART cycles were conducted for the treatment year 2013 across 2,639 clinics in 75 participating countries with a global participation rate of 73.6%. Reported and estimated data suggest 1,160,474 embryo transfers (ETs) were performed resulting in >344,317 babies. From 2012 to 2013, the number of reported aspiration and frozen ET cycles increased by 3% and 16.4%, respectively. The proportion of women aged >40 years undergoing nondonor ART increased from 25.2% in 2012 to 26.3% in 2013. As a percentage of nondonor aspiration cycles, intracytoplasmic sperm injection (ICSI) was similar to results for 2012. The in vitro fertilization (IVF)/ICSI combined delivery rates per fresh aspiration and frozen ET cycles were 24.2% and 22.8%, respectively. In fresh nondonor cycles, single ET increased from 33.7% in 2012 to 36.5% in 2013, whereas the average number of transferred embryos was 1.81—again with wide country variation. The rate of twin deliveries after fresh nondonor transfers was 17.9%; the triplet rate was 0.7%. In frozen ET cycles performed in 2013, single ET was used in 57.6%, with an average of 1.49 embryos transferred and twin and triplet rates of 10.8% and 0.4%, respectively. The cumulative delivery rate per aspiration was 30.4%, similar to that in 2012. Perinatal mortality rate per 1,000

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births was 22.2% after fresh IVF/ICSI and 16.8% after frozen ET. The data presented depended on the quality and completeness of the data submitted by individual countries. This report covers approximately two-thirds of world ART activity. Continued efforts to improve the quality and consistency of reporting ART data by registries are still needed.

Conclusion(s): Reported ART cycles, effectiveness, and safety increased between 2012 and 2013 with adoption of a better method for estimating unreported cycles. (Fertil Steril® 2021;■:■–■. ©2021 by American Society for Reproductive Medicine.)

Key Words: Assisted reproductive technology, IVF/ICSI outcome, frozen embryo transfer, ICMART, cumulative live birth rate, registry

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This is the 18th world report on assisted reproductive technologies (ART) and the 13th produced by the International Committee for Monitoring Assisted Reproductive Technologies (ICMART). ICMART has been generating annual world reports since 1989 (4). The current report presents data on ART performed in 2013, comprising country, region, and global estimates of ART utilization, effectiveness, and safety. Information on global ART practice, intrauterine insemination (IUI), and pregnancy and neonatal outcomes is also included.

MATERIALS AND METHODS

The process of data collection and analysis has been described in detail (1), and irrespective of the data collection system used by any particular country or region, data was adapted and transferred into the ICMART forms so that the information from all countries was standardized. Data of ART treatments conducted during 2013 were collected from regional or national ART registries or directly from individual clinics in a small number of countries where registries do not exist. Standardized forms, available in the ICMART Tool Box for ART (www.icmartivf.org), were used to collect information on the number of ART clinics and on procedure- and outcome-related information pertaining to in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), oocyte donation (OD), frozen embryo transfer (FET), preimplantation genetic testing (PGT), and IUI (with both husband/partner and donor sperm). Data were stratified by the woman's age and the number of transferred embryos. All data were provided at an aggregated country level and did not include any individual patient information. Collected data were transferred by ICMART to the Clinical Research Center at Uppsala University, Sweden, for further processing and analysis. Data were checked for inconsistencies, and a statistical report with tables and graphs was generated using SAS statistical software package (version 9.4) (Cary, NC, USA) and R (version 3.1.1). In countries and regions using individualized cycle-based registries, the data were transferred to the standardized ICMART forms by the regional or national representative.

The terminology used in this report was based on the 2009 ICMART and World Health Organization Revised Glossary on ART (2), which was the glossary in use in 2013. Future reports will refer to the updated International Glossary for Infertility and Fertility Care, created by ICMART in Partnership with the American Society for Reproductive Medicine (formerly The American Fertility Society), European Society of Human Reproduction and Embryology, International Federation of Fertility Societies, March of Dimes, African Fertility Society, Groupe Interafricain d'Etude, de Recherche et d'Application sur la Fertilité, Asia Pacific Initiative on Reproduction, Middle East Fertility Society, Latin American Network for Reproductive Medicine (REDLARA), and International Federation of Gynecology and Obstetrics (3). Data are presented by country, region, and globally. The Middle East region, which was distinguished for the purpose of data presentation into "Middle East" and "Middle East (Israel)" in previous reports, is represented by "Middle East (Israel)" alone in 2013 because of the lack of data from other countries in the region.

Most of the presented data were directly reported by countries or via regional registries. In a limited number of cases, some missing information needed to be estimated from other complementary fields in order to get a better perspective. All imputations are mentioned as notes beneath the relevant tables.

Institutional Review Board approval was not requested by ICMART because only anonymized aggregated data were collected and any relevant approvals were obtained at the country level by the entities submitting the data. None of the authors have any conflict of interest associated with this publication.

RESULTS

Key findings are summarized in Tables 1 and 2 and Figures 1 and 2 with additional results in Supplemental Tables 1–16 and Supplemental Figures 1–8 (available online).

ART Utilization

Seventy-five countries submitted data for treatments performed in 2013 (Table 1), an increase from 69 countries in 2012. Compared with the previous report in 2013, there were eight new countries (Ivory Coast, Mauritius, Senegal, Cyprus, Latvia, Macedonia, Malta, and Paraguay), whereas no data were received from Lebanon and Saudi Arabia. The number of clinics participating was 2,639—39 more than in 2012—and the global participation rate (calculated as all participating clinics divided by the estimated total number of clinics reported to exist) was 73.6% (Supplemental Table 1). Participation rates $\geq$80% were recorded in 44 countries (up from 40 in 2012) and in four regions (Australia/New Zealand, Europe, Middle East (Israel), and North America). Thirty-three countries and two regions (Australia/New Zealand and Israel) reached participation rates $\geq$95% (Supplemental Table 1). Europe had the highest number of participating clinics globally (1,169; representing 44.3% of all clinics), followed by Asia (30.6%) and North America

TABLE 1

Number of Procedures by Type of Procedure for the Year 2013.

		Non donation cycles[a]							
		Fresh cycles[b]				FET cycles[b]			
	Initiated cycles		Aspiration cycles			Thaw cycles	Transfer cycles	PGT cycles[a]	Oocyte donation transfer cycles[a]
Country name	Total	Total	IVF	ICSI	GIFT	Total	Total	Total	Total
Benin	104	86	5	81	NA	NA	NA	NA	NA
Cameroon	138	118	106	12	NA	3	3	0	27
Egypt	5,475	5,157	0	5,157	0	1,964	1,774	10	0
Ghana[c]	NA	264	NA	NA	NA	14	14	NA	NA
Ivory Coast	NA	77	77	NA	NA	NA	NA	NA	162
Mali	160	129	26	103	0	31	31	NA	NA
Mauritius	NA	126	40	86	NA	68	62	NA	0
Morocco	NA	552	86	466	NA	NA	135	NA	NA
Nigeria	NA	1,387	285	1,102	NA	119	107	13	806
Senegal	NA	61	0	61	NA	NA	NA	NA	0
South Africa	3,414	3,353	1,092	2,261	NA	466	431	NA	488
Togo	163	113	15	98	0	7	7	NA	47
Tunisia	NA	3,629	341	3,288	NA	591	566	NA	NA
India[c]	NA	16,970	NA	NA	NA	NA	8,155	NA	7,192
Indonesia	NA	3,556	271	3,285	0	592	587	NA	NA
Japan	227,414	221,960	87,022	134,871	67	141,213	138,175	NA	NA
South Korea	NA	29,513	9,162	20,351	NA	NA	10,164	NA	219
Australia[c]	38,024	34,677	NA	NA	NA	21,817	20,735	2,659	1,481
New Zealand[c]	3,196	2,992	NA	NA	NA	1,754	1,670	96	178
Albania	NA	91	0	91	NA	32	32	0	16
Austria	NA	5,821	916	4,905	NA	1,352	1,332	NA	0
Belarus	2,245	2,219	1,345	874	NA	175	131	12	19
Belgium	20,295	17,329	3,587	13,742	NA	10,001	8,879	628	832
Bulgaria	4,186	4,062	446	3,616	NA	890	875	20	280
Croatia	4,309	3,844	1,616	2,228	NA	466	466	NA	0
Cyprus	1,151	1,101	187	914	NA	330	288	50	155
Czech Republic	12,980	12,622	1,877	10,745	NA	NA	7,208	1,131	4,357
Denmark	11,584	11,220	6,155	5,065	NA	3,166	2,733	103	241
Estonia	1,824	1,806	639	1,167	NA	884	755	0	178
Finland	4,561	4,340	2,359	1,981	NA	NA	3,274	NA	740
France	NA	60,341	21,205	39,136	NA	NA	22,133	NA	994
Germany	NA	55,966	12,531	43,435	NA	20,456	19,582	NA	0
Greece	12,207	11,652	2,270	9,382	NA	2,024	1,961	397	3,617
Hungary	5,500	5,427	1,249	4,178	NA	NA	580	NA	66
Iceland	NA	395	222	173	NA	260	246	NA	134
Ireland	1,195	1,017	519	498	NA	371	324	0	0
Italy	55,049	50,173	7,008	43,165	NA	7,428	6,818	NA	0
Kazakhstan	3,288	3,273	1,575	1,698	NA	NA	645	78	478
Latvia	441	361	109	252	NA	124	124	2	107
Lithuania	343	338	190	148	NA	NA	37	0	0

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TABLE 1

Continued.

		Non donation cycles[a]							
		Fresh cycles[b]				FET cycles[b]			
	Initiated cycles		Aspiration cycles			Thaw cycles	Transfer cycles	PGT cycles[a]	Oocyte donation transfer cycles[a]
Country name	Total	Total	IVF	ICSI	GIFT	Total	Total	Total	Total
Macedonia	NA	1,546	305	1,241	NA	NA	114	NA	39
Malta	NA	100	0	100	NA	0	0	0	0
Moldova	866	836	392	444	NA	NA	66	0	34
Montenegro	NA	453	0	453	NA	22	21	NA	0
Netherlands	15,165	13,656	6,346	7,310	NA	NA	9,361	347	0
Norway	5,849	5,604	2,884	2,720	NA	NA	2,318	0	0
Poland	13,409	13,276	865	12,411	NA	6,151	5,961	253	985
Portugal	5,595	5,195	1,940	3,255	NA	1,334	1,230	68	360
Romania	1,839	1,740	960	780	NA	538	529	0	67
Russia	51,010	49,294	23,663	25,631	NA	11,879	11,518	838	3,525
Serbia	NA	2,720	550	2,170	NA	NA	NA	NA	0
Slovenia	3,671	3,514	1,064	2,450	NA	1,039	1,010	34	8
Spain	38,591	34,362	3,976	30,386	NA	14,255	13,152	2,890	18,113
Sweden	11,611	10,922	5,307	5,615	NA	6,063	5,444	172	385
Switzerland	5,420	4,896	739	4,157	NA	4,134	3,610	NA	0
Ukraine	10,971	10,450	2,862	7,588	NA	3,404	3,265	237	1,280
United Kingdom	45,402	42,999	19,021	23,978	NA	12,198	11,465	692	3,040
Argentina	7,774	6,958	744	6,214	NA	2,590	2,590	98	2,498
Bolivia	280	266	195	71	NA	17	17	1	49
Brazil	17,118	16,034	1,060	14,974	NA	6,128	6,128	1,103	1,740
Chile	1,658	1,535	130	1,405	NA	568	568	66	254
Colombia	977	901	288	613	NA	207	207	6	308
Dominican Republic	NA	48	18	30	NA	6	2	0	38
Ecuador	657	597	206	391	NA	167	167	10	282
Guatemala	NA	99	52	47	NA	18	18	4	21
Mexico	4,498	4,142	1,494	2,648	NA	960	960	106	1,814
Nicaragua	NA	96	29	67	NA	107	0	0	10
Panama	415	362	NA	362	NA	107	107	37	73
Paraguay	37	31	9	22	NA	2	2	0	0
Peru	1,406	1,307	470	837	NA	395	390	450	897
Uruguay	340	274	35	239	NA	55	55	1	75
Venezuela	1,223	1,076	438	638	NA	226	226	38	430
Israel[c]	28,667	NA	NA	NA	NA	10,507	9,960	NA	NA
Canada	16,026	14,578	3,935	10,643	0	8,294	7,969	483	1,421
United States	82,323	73,154	18,668	54,481	5	41,934	41,332	5,825	17,494
Africa	>9,454	15,052	>2,073	>12,715	NA	>3,263	>3,130	>23	>1,530
Asia	>227,414	271,999	>96,455	>158,507	>67	>141,805	157,081	NA	>7,411
Australia and New Zealand	41,220	37,669	NA	NA	NA	23,571	22,405	2,755	1,659
Europe	>350,557	454,961	136,879	318,082	NA	>108,976	>147,487	>7,952	40,050
Latin America	>36,383	33,726	>5,168	28,558	NA	11,553	11,437	1,920	8,489

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TABLE 1

Continued.

Country name	Initiated cycles	Non donation cycles[a]							PGT cycles[a]	Oocyte donation transfer cycles[a]
		Fresh cycles[b]				FET cycles[b]				
		Aspiration cycles				Thaw cycles	Transfer cycles			
	Total	Total	IVF	ICSI	GIFT	Total	Total		Total	Total
Middle East (Israel)	28,667	NA	NA	NA	NA	10,507	9,960		NA	NA
North America	98,349	87,732	22,603	65,124	5	50,228	49,301		6,308	18,915
Total	>792,044	>901,139	>263,178	>582,986	>72	>349,903	>400,801		>18,958	>78,054

Note: FET = frozen embryo transfer; GIFT = gamete intrafallopian transfer; ICSI = intracytoplasmic sperm insemination; IVF = in vitro fertilization; NA = not available; PGT = preimplantation genetic testing.
[a] Reported in the registers.
[b] Excluding PGT and oocyte donation cycles.
[c] Countries that did not separate ICSI and IVF.

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(15.6%). At a country level, Japan accounted for 22.2% of all participating clinics, followed by the United States (14.4%). In total, 24.1% of clinics performed <100 cycles (Supplemental Table 1), particularly in Asia (e.g., 91.7% of clinics in India). In contrast, 15.4% of clinics performed >1,000 cycles, with the highest proportions reported for Australia/New Zealand (47.1% of clinics) and Israel (44.0%).

Based on both reported and estimated numbers from participating countries, a total of >1,858,500 ART cycles were initiated in 2013 (Table 2), 90,398 (4.6%) less than in 2012 (>1,948,898). ART utilization, expressed as the global number of estimated cycles per million population, was 475 in 2013 compared with 520 cycles per million in 2012 with wide variations ranging from five cycles per million inhabitants in Senegal to 5,083 per million in Israel (Table 2) (4). Africa reported the lowest regional utilization (185 cycles per million), followed by Latin America and Asia with 200 and 320 cycles per million, respectively. Israel was the country that reported the highest regional utilization (5,083 per million) followed by Australia and New Zealand (2,599 per million). These trends were similar to ART utilization in previous years.

The number of fresh nondonor aspirations increased by 3% from >874,861 in 2012 to >901,139 in 2013 (Table 1). Japan contributed 24.6% of all nondonor aspirations, followed by the United States with 8.1% and France with 6.7%. The percentage of cycles fertilized by ICSI was 68.9% (similar to that in 2012) (Table 1). However, the use of ICSI and FET varied considerably by country and region. The reported number of nondonor FET cycles was >400,801 compared with >344,396 in 2012 (16.4% increase). Again, Japan (138,175), the United States (41,332), and France (22,133) conducted the largest number of FET cycles (Table 1). The percentage of FET among the total number of fresh and frozen transfers increased from 33.6% in 2012 to 37.4% in 2013 (Supplemental Table 2). Although Asia, mainly represented by Japan, contributed with the lowest proportion of ICSI (58.3%) and the highest proportion of FET (62.4%), Latin America contributed with 85% of ICSI and only 34% of FET.

Over 78,054 OD transfer cycles were reported compared with 71,347 cycles in 2012 (9.4% increase; Table 1), with fresh transfers comprising 60.4% of all transfers (63.3% in 2012) (Supplemental Table 12). By far, the two countries reporting the largest number of OD were Spain and the United States. Furthermore, >18,958 PGT cycles were reported compared with >18,700 in 2012. Overall, 1,160,474 embryo transfers (ETs) were performed (Table 1, Supplemental Tables 3, 4, 12, and 13), of which 670,519 were fresh IVF/ICSI, >400,954 were nondonor FET, 78,054 were OD (both fresh and FET), and 10,947 were PGT, representing a global 4.5% increment from the previous year.

ART Effectiveness

The global pregnancy rate (PR) and delivery rate (DR) per aspiration for fresh nondonor conventional insemination IVF (23.6% and 17.2%, respectively; Supplemental Table 2) were similar to those of the previous year. After fresh autologous

TABLE 2

Reported Data and ICMART Estimations (bold) for Year 2013.

			Fresh IVF and ICSI				FET	Fresh + FET			
Country name	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 babies[h,j] reported from participating clinics	Total[i,j] babies estimated from all clinics
Benin	86	36.0	30.2	30.2	36.0	36.0	NA	104	11	31	31
Cameroon	118	32.2	31.4	32.2	44.1	44.1	NA	**336**	**16**	65	**130**
Egypt[k]	5,157	37.3	28.6	33.7	43.2	50.8	22.2	24,800	291	2,626	NA
Ghana	264	37.9	**28.0**	**28.8**	NA	NA	NA	**1,465**	**58**	**92**	**460**
Ivory Coast	77	23.4	NA	NA	20.8	20.8	NA	**243**	**11**	70	70
Mali	129	48.1	48.1	48.1	NA	NA	NA	191	12	NA	NA
Mauritius	126	42.1	**31.0**	**41.3**	NA	NA	NA	**582**	**440**	**63**	**189**
Morocco	552	35.0	22.8	26.3	26.3	26.3	NA	**2utt13,032**	**399**	145	**2,610**
Nigeria	1,387	28.7	**21.1**	**21.3**	24.5	28.2	28.0	**12,025**	**69**	453	**2,265**
Senegal	61	37.7	27.9	27.9	34.4	34.4	NA	**61**	**5**	21	21
South Africa	3,353	26.6	**19.5**	**22.1**	NA	NA	NA	**6,240**	**128**	**893**	**1,276**
Togo	113	8.0	5.4	5.3	6.2	6.3	NA	**434**	**61**	11	**22**
Tunisia[k]	3,629	37.6	32.7	35.3	36.1	41.1	25.4	10,000	923	1,453	NA
India	16,970	34.8	**25.5**	**35.7**	41.2	58.3	35.6	**138,926**	**114**	13,084	**54,066**
Indonesia	3,556	31.8	**23.3**	**25.5**	28.8	33.6	21.8	**3,925**	**16**	1,152	**1,414**
Japan	221,893	10.1	6.9	18.7	4.7	29.8	24.1	368,627	2,897	43,747	43,747
South Korea	29,513	32.3	12.7	18.2	NA	NA	NA	**76,916**	NA	**6,507**	**11,915**
Australia	34,677	25.5	19.8	32.0	19.2	37.5	25.2	63,981	2,874	12,642	12,642
New Zealand	2,992	32.3	26.1	38.6	25.0	45.4	28.4	5,224	1,197	1,302	1,302
Albania	91	48.4	37.4	49.5	50.5	64.8	40.6	1,251	415	63	567
Austria	5,821	32.3	**23.7**	**29.2**	39.3	39.3	NA	**7,787**	**947**	2,286	**2,371**
Belarus	2,219	39.9	29.4	30.4	39.2	41.3	35.9	**3,268**	**340**	940	**1,253**
Belgium	17,329	26.9	19.5	27.7	23.3	34.9	22.7	31,756	3,041	6,458	6,458
Bulgaria[k]	4,062	22.9	16.8	23.2	20.7	28.8	37.5	5,376	770	1,296	NA
Croatia	3,844	25.6	15.1	17.6	17.7	20.8	26.0	**7,163**	**1,600**	801	**1,202**
Cyprus	1,101	31.4	27.5	36.8	NA	NA	NA	**1,967**	**1,702**	**540**	**630**
Czech Republic	12,622	28.9	20.3	32.2	22.6	38.2	27.4	25,962	2,555	6,397	6,397
Denmark	11,220	24.3	21.5	26.2	24.5	29.9	22.1	15,094	2,716	3,477	3,477
Estonia	1,806	26.3	20.0	23.6	24.2	28.4	10.1	2,886	2,279	558	558
Finland	4,340	26.7	20.3	36.6	21.5	39.1	23.2	8,705	1,653	1,695	1,695
France	60,341	23.5	19.7	25.5	22.4	28.7	17.2	**87,831**	**1,332**	17,725	17,725
Germany	55,966	28.0	19.5	24.8	24.0	31.0	20.2	**76,422**	**942**	17,376	17,376
Greece	11,652	31.5	14.5	17.3	17.6	23.9	37.6	**19,580**	**1,818**	4,434	**4,758**
Hungary	5,427	28.4	**20.8**	**23.0**	NA	NA	NA	6,169	621	**1,503**	**1,503**
Iceland	395	21.8	15.7	26.8	17.2	29.6	19.9	**812**	**2,575**	157	157
Ireland	1,017	36.1	30.3	37.9	35.4	43.5	25.3	**3,654**	**765**	442	**1,031**
Italy	50,173	21.4	14.2	16.5	17.4	20.2	21.3	62,477	1,016	10,160	10,160
Kazakhstan	3,273	40.1	28.9	34.0	33.7	39.4	28.7	**18,060**	**1,018**	1,516	**6,064**
Latvia	361	24.9	10.0	13.0	10.0	13.0	8.9	**1,348**	**619**	65	**130**
Lithuania	338	36.1	14.8	16.3	19.5	21.6	18.9	**635**	**181**	73	**122**
Macedonia	1,546	41.8	21.8	23.0	27.9	29.2	17.5	2,241	1,074	457	571

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TABLE 2

Continued.

	Fresh IVF and ICSI						FET	Fresh + FET			
Country name	**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 babies[h,j] reported from participating clinics**	**Total[i,j] babies estimated from all clinics**
Malta	100	28.0	28.0	28.0	31.0	31.0	NA	**100**	**243**	31	31
Moldova	836	39.6	35.9	37.7	47.4	49.3	24.2	969	268	439	439
Montenegro	453	36.9	30.7	31.6	37.5	38.4	19.0	**633**	**969**	174	**232**
Netherlands	13,656	30.8	22.2	32.7	23.5	34.5	16.1	25,244	1,502	4,710	4,710
Norway	5,604	31.2	25.3	33.1	NA	NA	NA	8,259	1,749	**2,237**	**2,237**
Poland	13,276	32.9	21.9	29.6	25.5	37.3	26.3	20,798	542	5,327	5,327
Portugal	5,195	30.5	22.7	27.2	27.1	33.0	25.0	7,357	681	1,904	1,904
Romania	1,740	38.3	27.1	32.2	33.8	44.1	33.8	**4,644**	**213**	795	**1,511**
Russia	49,294	32.1	22.9	27.3	28.2	34.4	26.5	**89,669**	**629**	18,253	**24,337**
Serbia	2,720	34.9	**25.6**	**25.6**	35.7	36.4	40.0	**3,400**	**469**	990	**1,238**
Slovenia	3,514	30.2	24.0	31.5	27.2	35.5	29.0	4,752	2,385	1,256	1,256
Spain	34,362	28.4	18.1	25.6	23.2	34.4	29.2	**112,478**	**2,374**	19,090	**29,076**
Sweden	10,922	29.7	24.0	36.2	25.3	38.0	25.4	**20,662**	**2,266**	4,280	**4,851**
Switzerland	4,896	22.1	16.1	28.3	18.7	32.9	19.2	**10,289**	**1,287**	1,609	**1,733**
Ukraine	10,450	35.8	27.5	36.9	34.8	47.3	39.9	**18,872**	**423**	5,630	**6,686**
United Kingdom	42,999	32.1	28.1	35.2	33.0	41.2	30.8	61,332	967	19,281	19,281
Argentina	6,958	24.9	18.5	24.5	20.2	31.6	23.7	**14,880**	**349**	2,868	**3,293**
Bolivia	266	27.7	20.5	21.8	42.9	44.7	23.5	347	33	142	142
Brazil	16,034	31.8	25.7	30.3	26.3	48.8	32.0	**55,905**	**278**	7,062	**15,133**
Chile	15,35	32.4	25.5	30.5	27.8	45.8	29.4	**3,183**	**185**	727	**909**
Colombia	901	32.5	27.6	30.9	32.6	43.2	30.4	2,830	62	522	986
Dominican Republic	48	39.6	35.4	35.4	50.0	50.0	0.0	**186**	**18**	38	**76**
Ecuador	597	40.5	31.6	34.7	35.8	48.1	27.5	1,116	72	410	410
Guatemala	99	51.5	40.4	44.4	63.6	68.7	27.8	**284**	**20**	88	**176**
Mexico	4,142	40.0	33.9	39.5	42.1	55.2	41.6	**17,918**	**154**	3,329	**8,085**
Nicaragua	96	33.3	32.3	32.3	37.5	37.5	NA	**217**	**37**	41	41
Panama	362	38.0	NA	NA	30.7	54.8	39.3	**1,896**	**533**	199	**597**
Paraguay	31	24.1	20.7	19.4	25.8	27.6	NA	39	6	8	8
Peru	1,307	21.9	17.0	22.6	15.6	41.1	42.3	**6,296**	**211**	924	**1,848**
Uruguay	274	38.3	30.1	32.8	38.0	42.0	16.4	471	142	144	144
Venezuela	1,076	36.1	28.5	31.4	33.7	44.0	29.6	**4,793**	**168**	636	**1,590**
Israel	**27,101**	**26.1**	**19.1**	**24.7**	NA	NA	NA	39,174	5,083	**8,058**	**8,058**
Canada	14,578	36.3	27.9	39.3	29.0	52.5	32.0	**29,608**	**857**	7,389	**8,342**
United States	73,149	41.4	33.5	56.3	42.7	70.3	48.8	**155,343**	**491**	62,950	**66,263**
Africa	15,052	33.9	26.7	30.2	37.7	42.8	23.1	86,513	185	>5,923	>7,074
Asia	271,932	16.0	9.7	27.3	11.0	32.8	24.7	588,394	320	64,490	111,142
Australia and New Zealand	37,669	26.0	20.3	35.7	21.5	38.1	25.4	69,205	2,599	13,944	13,944
Europe	454,961	28.3	20.8	26.9	24.8	32.5	23.5	779,902	1,043	164,425	>189,054
Latin America	33,726	31.6	25.2	35.5	32.7	45.1	30.7	110,361	200	17,138	33,438
Middle East (Israel)	27,101	26.1	19.1	24.7	NA	NA	NA	39,174	5,083	8,058	8,058

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TABLE 2

Continued.

	Fresh IVF and ICSI						FET	Fresh + FET			
Country name	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 babies[h,j] reported from participating clinics	Total[i,j] babies estimated from all clinics
North America	87,727	40.7	32.7	54.5	41.2	67.6	46.1	184,951	527	70,339	74,605
Total	928,168	26.7	19.6	30.4	24.0	37.3	27.3	1,858,500	475	>344,317	>437,315

Note: 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).
Asp = aspirations; Cumul = Cumulative rate per aspiration, computed by adding the FET deliveries and babies to those obtained after fresh cycles, the sum being divided by the number of aspirations; DR = delivery rate; FET = frozen embryo transfer; ICMART = International Committee for Monitoring Assisted Reproductive Technologies; ICSI = intracytoplasmic sperm insemination; IVF = in vitro fertilization; NA = not available; OD = oocyte donation; PGD = preimplantation genetic diagnosis; PR = pregnancy rate.
[a-j] Imputed/estimated data printed in bold.
[a] Imputed when not reported by applying the average cancellation rate to the number of initiated cycles.
[b] Imputed when not reported by calculating the number of aspirations from the number of initiated cycles reported.
[c] Imputed when not reported by calculating the mean percentage of deliveries per pregnancy.
[d] Imputed when not reported 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 the 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 2012 (CIA World Fact Book).
[h] Imputed by multiplying the 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 OD.
[k] No calculations conducted because of missing data and only the number of reported estimated cycles presented.

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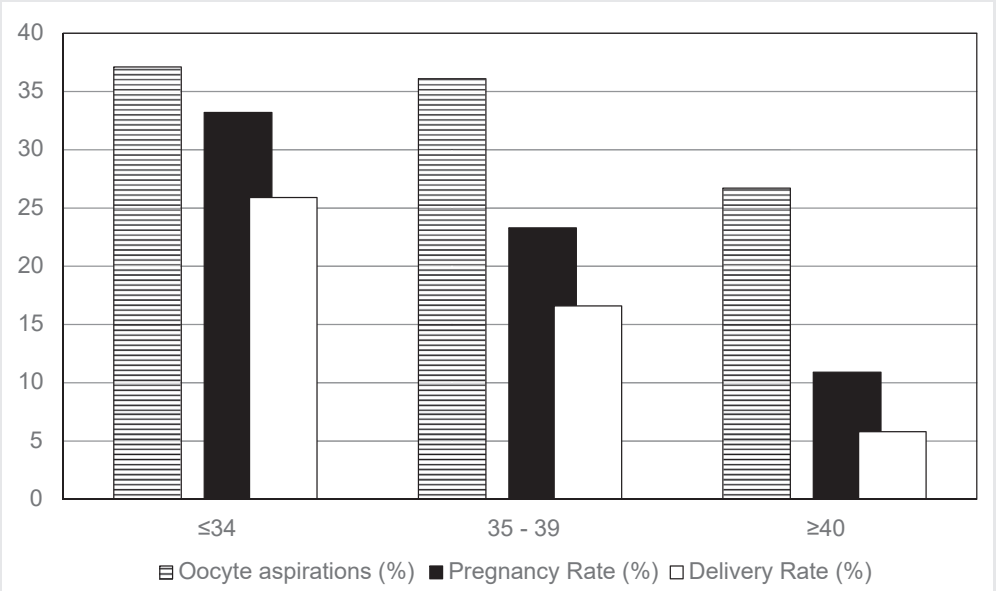
FIGURE 1



	≤34	35 – 39	≥40
Oocyte aspirations (%)	37.1	36.1	26.7
Pregnancy rate (%)	33.2	23.3	10.9
Delivery rate (%)	25.9	16.6	5.8

Fresh nondonor IVF and ICSI: distribution of aspirations and outcomes by women's age for the year 2013. ICSI = intracytoplasmic sperm injection; IVF = in vitro fertilization.

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ICSI, the PR and DR were 24.2% and 17.5%, respectively, similar to those in 2012. For FET, the PR per transfer increased to 32.4% from 31.5% in 2012. The DR per transfer was 22.8% and the estimated cumulative DR per aspiration after IVF/ICSI was 30.4% (range 5.3%–56.3%, Table 2), similar to that in 2012 (28.9%).

Supplemental Figure 1 shows the DR per aspiration for countries reporting this measure and Figure 2 shows the estimated DR for a further ten countries in which the DR was estimated. The figures show very large variation (range <10% to >45%), which may in part reflect differences in the proportion of freeze-all cycles.

The rate of early pregnancy loss was 19.4% following fresh ET and 24.2% following FET. Both rates showed wide regional and national variation (Supplemental Table 5) and were similar to findings in 2012 (19.5% and 23.7%, respectively).

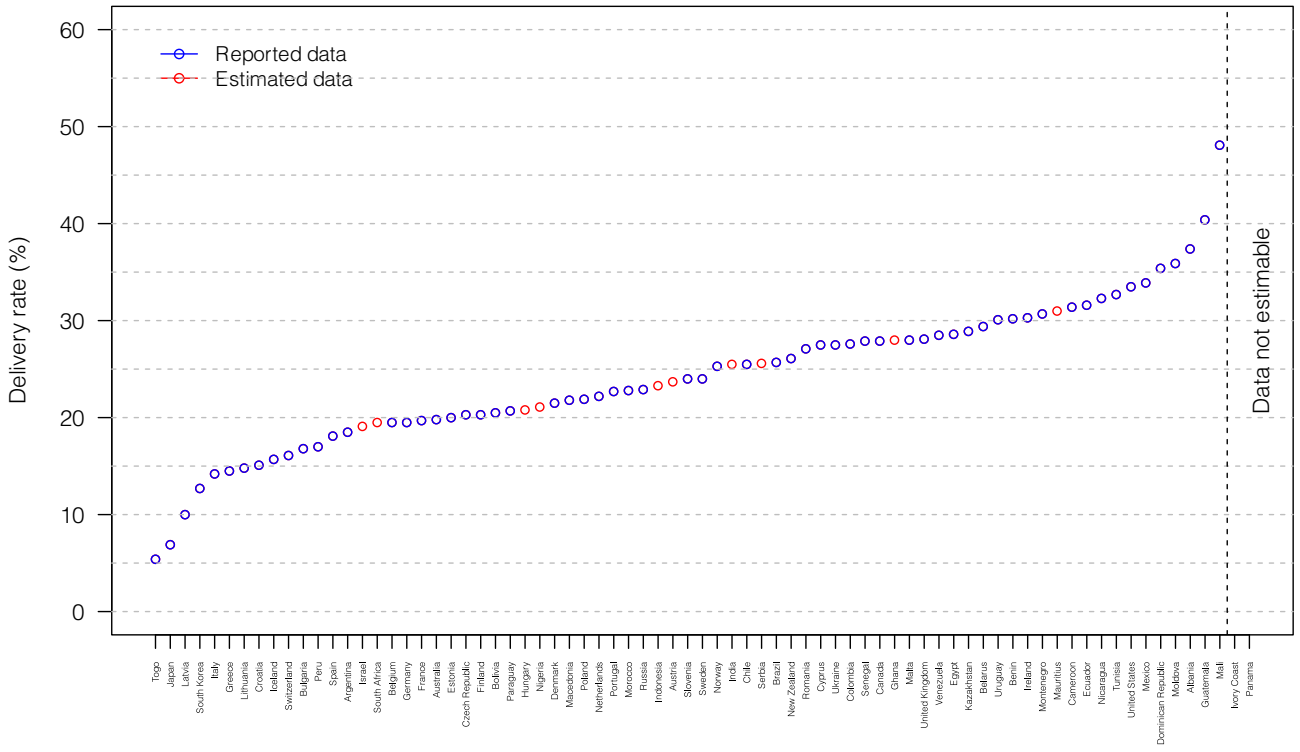
Globally, participating clinics reported >344,317 babies born—an increase of 6.7% over 2012 (>322,800, Table 2). When nonreporting clinics from participating countries were included, an estimated total of >437,315 babies were born following ART.

The proportion of women aged ≥40 years who underwent nondonor aspirations increased progressively from 24.0% in 2011 and 25.2% in 2012 to 26.8% in 2013. Africa had the lowest proportion at 15.7% and Asia the highest at 43.3%, basically resulting from 45.9% of women being ≥40 years old in Japan (Supplemental Table 6). The respective PR and DR following fresh ETs in this age group were 10.9% and 5.8% in 2013, similar to those in 2012 (9.9% and 5.4%, respectively) (Supplemental Table 7). For nondonor FET cycles, the proportion of women aged ≥40 years increased from 21.6% in 2012 to 22.7%. The PR and DR in these women were 23.7% and 13.9% in 2013 compared with 24.8% and 14.4% in 2012, respectively (Supplemental Table 8).

ART Safety

The average number of embryos transferred in fresh nondonor IVF/ICSI cycles was 1.81 (Supplemental Table 3) continuing the decreasing trend observed in 2012 (1.88). In these cycles, the global rate of single ET (SET) increased significantly from 33.7% in 2012 to 36.5%, while the transfer of three embryos decreased from 14.8% to 13.0% and that of ≥4 embryos decreased from 3.1% in 2012 to 1.9%, respectively (Supplemental Table 3). The highest regional rate of SET was reported by Australia/New Zealand (74.4%) and the lowest by Africa (14.0%) and Latin America (16.9%), similar to the 2012 data. The latter two regions also showed the highest proportion of ≥3 embryos transferred. The number of countries having a proportion of SET >70% increased

FIGURE 2



Fresh nondonor IVF and ICSI: reported and imputed delivery rate per aspiration by country for the year 2013.

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from 4 in 2012 to 5 (Japan, Australia, New Zealand, Finland, Sweden).

For nondonor FET, the average number of embryos transferred similarly decreased from 1.54 in 2012 to 1.49 in 2013 (Supplemental Table 4). The rate of SET continued to increase from 54.8% in 2012 to 57.6%, substantially higher than the SET rate in nondonor fresh transfers (36.5%). Five countries had a proportion of cycles with SET >70% (Japan, Australia, New Zealand, Finland, Sweden), unchanged from 2012.

The PR and DR by number of transferred fresh and frozen embryos in nondonor IVF and ICSI cycles are reported in Supplemental Tables 9 and 10. The global DR for fresh nondonor SET was 21.5% (21.2% in 2012) compared with 29.0% following double ET (DET) (28.7% in 2012). In nondonor FET cycles, the DR for SET was 22.9% (23.4% in 2012) compared with 24.9% following DET (24.0% in 2012). The mean number of embryos transferred in fresh nondonor cycles by country is shown in Supplemental Figure 2 and varied from 1.23 to 3.14. The DR by country, ranked according to the average number of transferred embryos, is shown in Supplemental Figures 3 and 4.

The triplet DR ranked by country in fresh nondonor IVF and ICSI cycles showed large variations across countries and a significant correlation with the mean number of embryos transferred ($r = 0.57$; $P<.0001$; Supplemental Figures 5–7). Highly significant correlations also existed between the mean number of embryos transferred and the rate of multiple deliveries ($r = 0.90$; $P<.0001$), and prematurity ($r = 0.58$; $P=.0005$) (Supplemental Figure 8).

Globally, the multiple birth rate (MBR) following fresh nondonor ET was 17.9% for twins and 0.7% for triplets and higher (Supplemental Table 3), similar to results for 2012 (18.0% and 0.8%, respectively). Regional rates of twin births ranged from 5.8% for Australia/New Zealand to 24.5% for North America. Regional rates of triplet and higher-order births ranged from 0.1% in Australia/New Zealand to 1.2% in Asia, which was a result of 3.5% of triplets and higher in India and none in Japan (Supplemental Table 3). For nondonor FET cycles, twin as well as triplet and higher-order birth rates were 10.8% and 0.4%, respectively (Supplemental Table 4), very similar to rates in 2012.

The preterm DR was 22.2% following fresh ETs and 16.8% in FET cycles, both similar to 2012 results (22.4% and 17.8%, respectively). The perinatal mortality rate (per 1,000) for FET cycles was 15.9 (the same as in 2012) but increased in fresh ETs from 21.4 in 2012 to 25.9, which retrospectively we know was related to a misregistration in some Latin American countries (35%) in that specific year and the absence of data from all European countries (Supplemental Table 5).

The frequency of severe ovarian hyperstimulation syndrome (OHSS) (associated with severe illness or

hospitalization) remained poorly reported and unchanged from 2012 at 0.4% per cycle (Supplemental Table 11).

Special techniques—OD, PGT, in vitro maturation, surrogacy, and fetal reduction. Fifty-one countries provided data on OD (compared with 49 countries in 2012) (Supplemental Table 12). Reporting clinics performed 78,054 fresh and frozen transfers using donor oocytes—an increase of 9.4% from 2012. Spain recorded the highest number of OD transfer cycles (18,113), accounting for 23.2% of all OD transfer cycles globally. Transfers using donated oocytes constituted 7.0% of all ETs (6.5% in 2012), with wide variations: 12.7% in North America, 18.4% in Latin America, and only 2.6% in Asia.

The average DR following OD including both fresh transfers and FET was 34.4% with a total of 33,812 babies born. The global multiple DR following OD was 26.9%, similar to that in 2012 (27.6%) with large variations, ranging from 38.7% in India to 6.5% in Australia/New Zealand. Women aged >40 years old represented 66.6% of oocyte recipients (Supplemental Table 12).

Thirty-nine of the 75 reporting countries (52.0%) provided information on PGT (Supplemental Table 13) compared with 37 (53.6%) in 2012. The number of reported PGT cycles was >18,958 (+1.4%; >18,700 in 2012), resulting in 10,947 ETs (Supplemental Table 13), 4,788 pregnancies (27.7% per aspiration, 44.9% per transfer), and 4,407 deliveries (22.2% per aspiration).

Countries reporting in vitro maturation (IVM) decreased from 11 in 2012 to 2 in 2013. Gestational surrogacy was reported by seven countries (6 in 2012), and 25 countries reported availability of fetal reduction (Supplemental Table 11).

Intrauterine insemination. Data on 211,026 IUI cycles with husband sperm (IUI-H, with or without ovarian stimulation) were provided by 48 countries (14 countries and 1.5% cycles higher than in 2012), mostly from Europe, where 27 countries reported 175,466 cycles. The global PR and DR per IUI-H cycle were 11.8% and 8.9%, respectively. The rate of multiple deliveries was 10.3%, with a wide country range (Supplemental Table 14). The DR for women aged ≥40 years was 4.2% per cycle.

Thirty-seven countries reported 47,424 cycles of IUI with donor sperm (IUI-D). The resultant PR and DR per cycle were 17.3% and 11.3%, respectively. The multiple DR was 7.5%, lower than that of IUI-H (Supplemental Table 15).

Cross-border care. Cross-border reproductive care (CBRC) was reported by 21 countries (13 from Europe, five from Africa, and Indonesia, Canada, and the United States). The United States reported the largest proportion of the total with >11,612 nondonation and >3,031 OD cycles (77.1% and 69.7%, respectively), followed by Denmark (nondonation cycles) and Spain (OD cycles). Among the 5,849 cycles for which the country of origin was reported, citizens who crossed borders to obtain care came most often from Italy (1,204), Canada (1,033), Algeria (882), United Kingdom (627), and Mexico (374) (Supplemental Table 16). The main reasons for CBRC were quality of care (27.1%), legal (24.2%), and access (22.7%).

DISCUSSION

The ICMART World Collaborative Report on ART, 2013 is the 18th ICMART World Report, another comprehensive global statistical report on ART services. These ICMART World Reports help at a global, regional, and local level to guide policy formulation, clinical practice, education, and advocacy. Besides publication in journals, ICMART presents these data at major global meetings and works with other professional organizations and the World Health Organization (WHO) as a non-State actor in official relationship with WHO to increase the impact of these data to improve access to fertility-related treatment and quality of care.

This report summarizes global and regional results for treatments performed in 2013 and tabulates as well as graphically illustrates detailed outcomes in tables and figures. ICMART endeavors to standardize reporting that tracks trends over time. Continual monitoring of international ART practice and outcomes is essential to quantify comparative utilization levels, monitor effectiveness of treatment, and identify safety issues and helps all stake holders: governments, policy makers, service providers, and patients.

After imputing missing clinic data, participating countries conducted >1,858,500 cycles, a decrease of 4.6% compared with 2012 (>19,848,898) (Table 1). The number of participating countries and clinics increased from 69 and 2,600 in 2012 to 75 and 2,639 in 2013, respectively, with the global participation rate at 73.6% of the estimated number of existing clinics; 31 (30 in 2012) countries reported 100% participation (Supplemental Table 1).

Europe had the highest proportion of all participating clinics (44.3%) followed by Asia (30.6%) and North America (15.6%). The Middle East had the lowest proportion of global clinics participating at 0.9% because the only country participating was Israel, but Israel itself had 100% participation. The absence of an official national or regional data collection system in countries from the Middle East makes registration inconsistent in those countries. Saudi Arabia and Lebanon reported in the previous year, but no data could be collected in 2013. Multiple efforts have been made to stimulate centers in this region to use a standardized data collection system to benefit their own region and to be shared with ICMART. Currently, Egypt is using software distributed by the African network and registry of ART (ANARA) and many more centers will start contributing their data in future reports.

ART utilization, expressed as the global number of estimated cycles per million population, changed from 520 in 2012 to 475 in 2013. This change, together with the reduction in total number of ART cycles between 2012 and 2013, must in part be attributed to the fact that for three countries (Egypt, Tunisia, and Bulgaria) no imputation was made to estimate total number of cycles conducted in the country (based on the number of cycles reported to ICMART) as the margin of error for such an estimate was deemed to be too big. As a result, ART utilization dropped significantly in these 3 countries in 2013 compared with that in 2012. ICMART has recently documented a new approach to the reporting of ART utilization (5). Although this new approach will be fully applied to the 2014

world data, it was already applied to the three counties in question in 2013.

This change also accounts for the substantial drop in regional ART utilization in Africa, from 587 cycles/million population in 2012 to 185 cycles/million population in 2013. The adjusted rate of ART utilization in Africa in 2013 was similar to that of Latin America (200 cycles/million population). This similarity was more likely to represent the reality in these two regions than the discrepancy reported in 2012 (587 cycles/million population [Africa] versus 182 cycles/million population [Latin America]).

Based on the notion that ART utilization reflects access to care, the latter varied greatly among countries and regions. Israel had consistently the highest level of access with >5,000 cycles per million population; Australia and New Zealand had almost 2,600 cycles and Europe had >1,000 cycles/million ranging from 181 cycles/million in Lithuania to 3,041 cycles/million in Belgium. In contrast, utilization was low in Latin America and Africa as already mentioned (Table 2). Low utilization rates in the developing South were in stark contrast to the high infertility burden (6, 7). Cost of treatment in conjunction with lack of government or medical insurance funding, competing health needs, lack of ART services outside the private health sector, and lack of recognition of infertility as a disease were some of the most prominent barriers in access to ART in these 2 regions. Similar barriers exist in India and many parts of Asia.

Substantial disparities in utilization existed also within regions; in Europe, utilization varied from 181 (Lithuania) to 3,041 (Belgium). The overall global utilization of 475 cycles per million population is far less than the need and demand estimation for ART treatment—3,000 and 1,500 couples per million population, respectively (8). In 2013, only two regions and 17 countries, respectively, reached the latter benchmark, mostly in Israel, Europe, and Australia and New Zealand (Table 2).

ART Practice

Globally, the number of reported fresh nondonor aspirations increased by 3% while the number of nondonor FET cycles increased by 16.4%, and the percentage of FET among the total number of fresh and frozen transfers also increased (+3.8%); these trends could be because of the recent introduction of the concept of segmentation and OHSS-free clinic (9) leading to higher "freeze-all" cycles, lower number of fresh ETs, and more FETs/aspiration cycle.

The proportion of ICSI cycles stabilized at approximately two-thirds of aspiration cycles (10) (Table 1). ICSI utilization varied from 62.1% in Asia to 85.9% in Africa, with large disparities across countries within a region. This was despite its proven benefit in severe male factor infertility only and a possible reduction of total fertilization failure; its use for non-male factor infertility (unexplained, poor quality oocytes, advanced maternal age, or low oocyte yield) not showing any benefit in improvement of live birth outcomes (11, 12). This was possibly related to differences in the prevalence of male infertility and in ART practice across regions—related to insurance policies, federal and state legislations, and practice economics (13, 14).

Consistent delay in childbearing and declining fertility potential with advancing maternal age has led to increase in the usage of donated oocytes. Evolving social and cultural norms in both developing and developed countries may favor the continuing OD practice (15). The number of OD cycles, as a proportion among the total number of cycles, has been consistently increasing; now representing 7.03% of all transfer cycles (Table 1) compared with 6.5% in 2012 and 6% in 2010 (16). OD was also governed by national legislation policies, societal-religious norms, availability of cross-border care, and funding arrangements. Hence, marked variations were noted within regions and countries, and these may govern global access to potential users (15). OD is not available in Japan, most countries of the Middle East, and parts of Europe and Africa. Even in countries where it is available, the demand for donors surpasses the availability or vice versa. Therefore, OD services often are provided to cross-border patients to alleviate this demand–supply mismatch.

Cross-border care is still an unregulated area where data collection is challenging and oversight is limited. Couples generally travel to countries where ART services are cheaper, more effective, or include those that are unavailable or inaccessible in their country of origin. Factors governing cross-border care include regulations/laws in incoming and outgoing countries, single-partner treatment, PGT, surrogacy, compensation for third party reproduction, financial issues, and perceived quality of care (15, 17, 18). ICMART continues to promote the importance of obtaining and reporting data on CBRC.

The number of PGT cycles reported in 2013 was similar to that in 2012 (Table 1). However, North America and Latin America both showed an increase compared with results for 2012 (6,308 vs. 5,509 and 1,920 vs. 1,678, respectively) whereas in Europe it decreased from 8,433 in 2012 to 7,952 in 2013. The limitation was that only the initiated and transferred reported cycles could be included and the intent to perform PGT for aneuploidy (PGT-A) cannot be captured.

These regional differences in PGT utilization may be explained by the varied reporting formats of agencies (Society for Assisted Reproductive Technology and Human Fertilisation and Embryology Authority), different funding policies of the regions, governing laws and regulations, and the perceived clinical utility of PGT-A as an IVF adjunct. In 2013, out of 46 countries where PGT was allowed, in 38 it was regulated by guidelines, statutes, and laws (19). The majority of the ART cycles in the United Kingdom are funded by the National Health Services (40%) or are carried out in public/university hospitals without any funding. In fact, Human Fertilisation and Embryology Authority considers PGT-A as an unproven add-on (labeled as red in their traffic light system) and does not report PGT-A data in its annual report (20). In contrast, in the United States, the majority of the treatments are self-funded and more women opt for PGT-A as there is a bigger commercial ART market predominantly run by private clinics or hospitals and more permissive PGT-A rules and regulations enable its use (21–24).

Continuing advancements in molecular methods like array comparative genomic hybridization and next generation sequencing and genetic diagnostic techniques for PGT-A, PGT-M (for monogenic/single gene defects), and PGT-SR (for chromosomal structural rearrangements) will likely result in overall increasing use of PGT (15, 25). PGT-A is promoted, particularly in women of advanced maternal age and those with repeated implantation failure or miscarriages, to improve embryo selection and also is used to promote SET. However, the optimal clinical utility of PGT-A still remains controversial, with some studies concluding it is useful (26, 27) and new randomized trials reporting no improvements in PRs (28, 29). However, these have been challenged by factors related to wrong diagnosis and biopsy-related damage (30).

Effectiveness

There is a lack of consensus regarding suitable numerators, denominators, and time spans and the various metrics to assess ART outcomes. This may be mitigated by implementation of standard definitions in the recently published International Glossary on Infertility and Fertility Care (3). With the increase in the practice of segmentation and elective SET (eSET), the ideal measure would be the cumulative live birth rate (combining the outcomes of FET cycles with the associated fresh cycle) as PR and DR per fresh cycle does not reveal a real estimation of ART efficiency in segmented cycles (31). This is also the measure that matters most to the patient, i.e., healthy baby per intention to treat (32). Precise cumulative data extraction from all the countries and regions may not be feasible as ICMART receives aggregate data instead of individual cycle data. SART has begun to report cumulative data for live births. Cumulative data can also be extrapolated as described previously (1).

The cumulative DR per aspiration resulting from fresh transfers (self and donor) has been steadily increasing from 25.7% in 2008 to 28.9% in 2012 to 30.4% in 2013 (Table 2). Simultaneously, the fresh SET rate increased to 36.5% and the FET SET rate to 57.6% (Supplemental Table 3), which were higher compared with results for the previous years (16, 33). The DR for fresh SET was 21.5% and for FET SET was 22.9% (Supplemental Table 9). The latter compares exceptionally favorably with the DR for FET DET, which was 24.9%, although SET had a dramatically lower MBR. The increment in DR per ET when transferring two embryos (DET) over SET shows major differences between countries and the reasons for this are in part associated with the fact that in countries where >70% of transfers are SET (elective), DET is used for poorer prognosis cases, whereas in countries or regions where the first choice is DET, SET is conducted mostly when no other embryos are available for transfer (nonelective).

The favorable trend toward eSET in fresh and frozen cycles has been facilitated by the clinical practice of blastocyst culture and improvements in the vitrification process leaving a higher number of better-quality embryos for freezing and subsequent FET. Another possible reason promoting the use of FET could be the emerging evidence that pregnancy and neonatal outcomes were equivalent or even better than those of fresh transfers (34, 35). However, there is need for more evidence to justify this practice with recent studies pointing toward adverse maternal and neonatal outcomes after FET (36–38).

Safety

The proportion of women aged ≥ 40 years undergoing ART increased steadily since 2011, both at aspiration (26.8% vs. 24.0%) and for OD (66.6% vs. 60.5%) (Supplemental Tables 6 and 12). This trend could be because of delayed marriages, career choices, and possibly increased access to OD (39, 40). Women with advanced maternal age are at a higher risk of adverse obstetrical and perinatal outcomes and need appropriate counseling regarding low PRs and DRs when they plan pregnancy (41).

The average number of embryos transferred in fresh nondonor IVF and ICSI cycles has consistently decreased every year with a parallel increase in the percentage of SET and reduction in transfer of ≥3 embryos both in fresh and nondonor FET cycles. However, there was considerable variation in the number of embryos transferred and, consequently, MBRs among countries and regions. In 2013, 8 countries (Japan, Australia, New Zealand, Albania, Finland, Iceland, the Netherlands, and Sweden) reported fresh cycle MBRs of <10% (Supplemental Table 3), 1 country less than in 2012.

The MBR following fresh and frozen nondonor ETs was similar to that in 2012. Over the past two decades, the risks of multiple pregnancies have been well recognized by many countries, and they have established firm guidelines and mandatory legislations to limit the number of embryos to be transferred in ART. In 2013, only 22 out of 58 (38%) reporting countries had guidelines or laws governing SET (24). Use of blastocyst stage ET, increased utility of PGT-A, and increased appreciation of the risk of twins has led to a consistent decrease in the number of embryos transferred per ET. Previous unsuccessful attempts and long duration of infertility with added financial burden and growing commercialization of ART centers were often the driving forces for patients and physicians to opt for multiple ET. There is an urgent need for global efforts, professional guidelines, mandates, patient education, and financial subsidies to promote SET and bring the multiple pregnancy rate to <10% (42). The risks of multiple ETs are well established and the reasons for why this practice prevails nonetheless have been previously discussed (43, 44).

The frequency of severe OHSS (associated with severe illness or hospitalization) remained similar to that in 2012 (0.4%) (Supplemental Table 11). Increased use of gonadotropin-releasing hormone (GnRH) antagonist protocols with GnRH analog triggering may further reduce it in the years to come, and the possible reporting bias by varied definitions may be overcome by adopting uniform criteria for defining severity (45).

There was a sharp drop in countries reporting IVM. IVM has become less popular because of the dearth of data

regarding safety and the perceived lower clinical success rates. Similarly, fetal reduction has also declined owing to the reduction in multiple pregnancies with increasing SET and PGT-A (15).

Limitations and Strengths

The data presented clearly depended on the quality and completeness of the data submitted by individual countries either directly to ICMART or through regional registries. Although possible data errors and inconsistencies were queried with country/region representatives, further validation of the data was not possible because the ICMART Registry is based on data summaries. The quality and completeness of the data in turn reflected local data collection practices, in particular whether national data supply was mandatory or voluntary and if national/regional registries were themselves based on clinic summaries or on individual cycles data, with or without controls for validity.

Of the 60 reporting countries, 74% had a licensing body to regulate the practice of ART in 2013 and 90% had some regulation of ART via legislation or guidelines or both; 77% reported improvement in legislation over the past year. However, some of the most populous countries did not have registries or had incomplete or inconsistent tallies (19). Data quality varied by country and region and needs continuous efforts to be improved. Finally, an important limitation of our report was that some regions had a low participation, for example the Middle East, India, and Africa and, above all, that it does not have data from China, which represents a significant proportion of the missing data. Efforts are being made to develop contacts with China to solve this problem. Moreover, there is a need to collect accurate data regarding peri-natal mortality from all countries.

However, this report covers approximately two-thirds of the world ART activity. ICMART, as a non-State actor in official relations with the WHO, works at global, regional, and national levels to facilitate data collection: to assist countries and regions to establish national and regional ART registries, such as in sub-Saharan Africa (ANARA); to facilitate data collection through standard, consensus data definitions provided by the International Glossary on Infertility and Fertility Care (3); and by providing a data collection "toolkit", and an electronic data collection platform (46).

CONCLUSION

The ICMART World Reports have provided the most comprehensive global statistical census and review of ART utilization, effectiveness, and safety since 1989. The 2013 report saw a reduction in estimated number of ART cycles and ART utilization, with wide disparities in access to treatment among regions and countries. However, the number of reported cycles increased; the reason for the discrepancy was a different method of calculating our estimations that will be fully implemented in the 2014 report. The number of embryos transferred continued to decrease with increasing use of SET. This along with increasing use of segmentation led to a rise in the percentage of FETs. However, the MBR in most countries remained unacceptably high and should be the focus of continued policy and practice improvement. The use of new technology, especially PGT-A, showed variation among continents because of differences in regulation and type of ART practices. ICMART continues to support countries and regions in data collection and is making significant progress in improving the comprehensiveness, analysis, and reporting of worldwide ART data.

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