

# World Collaborative Report on Assisted Reproductive Technology, 2002

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The International Committee for Monitoring Assisted Reproductive Technology's (ICMART) Eighth World Report analyzes assisted reproductive technology (ART) practice and results for the year 2002 from 53 countries by type of ART, women's age, number of embryos transferred and multiple births. Over 601 243 initiated cycles resulted in a delivery rate (DR) per aspiration of 22.4% for conventional IVF, 21.2% for ICSI and a DR per transfer of 15.3% for frozen embryo transfer. For conventional IVF and ICSI, there was an overall twin rate of 25.7% per delivery and a triplet rate of 2.5%. The number of babies born worldwide through ART in 2002 was estimated to range between 219 000 and 246 000. There were wide variations in availability, DRs and multiple birth rates across the countries. Compared with the previous report (year 2000), there was a large increase in the number of cycles and a slight increase in the DR. There was a marginal decline in the mean number of embryos transferred and in the multiple DRs.

**Key words:** assisted reproductive technology / registries / outcomes / multiple pregnancies / public health

## Introduction

This is the Eighth World Report on assisted reproduction technologies (ART) produced by The International Committee for Monitoring Assisted Reproductive Technology (ICMART), since 1989 (IWGROAR *et al.*, 1993, 1995, 1997, 1998, 2001a, b; ICMART *et al.*, 2006). It represents an overview of the World practice and results in ART for the year 2002 and allows comparisons between countries and regions, and analysis of trends by comparing to the previous reports.

## Materials and Methods

Data were collected as follows. Five regional registers gathered data either from national registries (Europe, North America and Australia–New

Zealand—ANZ) or from individual ART units (Latin America and Middle East). In Asia and Israel, data were sent directly to ICMART from national registries.

The ICMART data collection uses forms describing the organization of each country register and the results of IVF, ICSI and frozen embryo transfer (FET): initiated cycles, aspirations, transfers, clinical pregnancies, deliveries and newborns. These variables are further classified according to the fertilization technique, women's age, number of embryos transferred and gestational age at delivery. Other forms describe preimplantation genetic diagnosis (PGD), oocyte donation (OD), immediate complications for women and congenital anomalies detected during the perinatal period. The ICMART-World Health Organization glossary (ICMART *et al.*, 2002, Zegers-Hochschild *et al.*, 2006a, b) was used as reference for terminology. The report covers ART initiated during the year 2002 and is based on aggregated country data.

Data are presented by country and region. When the number of initiated cycles was unavailable in a register, estimation was made by

**Table I** General data: distribution of procedures, year 2002

Country	Non-donation cycles					FET cycles <sup>1</sup>			PGD cycles	Oocyte donation	Overall number of cycles	
	Fresh cycles <sup>1</sup>					Thaw cycles		Transfer cycles	Transfer cycles	Estimation <sup>3</sup>	Availability <sup>4</sup>	
	Initiated cycles <sup>2</sup>	Aspiration cycles				Total	Total	Total	Total	Total	Cycles/ million n	
	Total (n)	Total	IVF	ICSI	GIFT	Total	Total	Total	Total	Total		
India	NA	7584	3779	3805	0	1125	742	735	0	15 525	15	
Japan	23 323	22 202	11 186	10 975	41	5280	4931	0	0	71 695	564	
South Korea	15 998	15 123	8593	6528	2	1989	1866	NA	286	28 493	590	
Australia	NA	16 113	7300	8625	188	11 485	10 683	673	952	30 895	1568	
New Zealand	NA	1703	849	854	0	817	748	0	107	2804	710	
Belgium	NA	8892	3116	5776	NA	3009	2351	346	561	22 884	2222	
Bulgaria	838	794	499	295	NA	28	28	0	16	1617	216	
Croatia	2048	2015	1237	778	NA	573	497	0	0	2621	596	
Cyprus	990	931	454	477	NA	42	36	0	0	1032	1290	
Denmark	9630	9147	5684	3463	NA	1543	1300	0	123	11 296	2100	
Finland	4369	4250	2579	1671	NA	3146	2746	44	0	7559	1456	
France	53 769	46 779	21 557	25 222	NA	12 284	10 997	0	0	66 053	1098	
Germany	68 984	62 129	24 146	37 983	NA	15 835	14 234	0	0	91 400	1109	
Greece	5075	4840	2007	2833	NA	343	328	2	159	23 246	2179	
Hungary	6518	6117	1945	4172	NA	257	230	7	28	6810	678	
Iceland	NA	260	145	115	NA	75	72	0	16	378	1350	
Ireland	1519	1383	845	538	NA	390	272	0	3	1912	488	
Italy	15 358	13 247	5244	8003	NA	2431	2267	534	554	33 810	583	
Macedonia	241	225	128	97	NA	0	0	0	0	241	117	
Netherlands	14 767	13 269	8493	4776	NA	1468	1468	38	0	16 273	1008	
Norway	3911	3782	2254	1528	NA	269	172	0	0	4180	919	
Poland	3349	3259	851	2408	NA	901	782	0	51	4874	126	
Portugal	2541	2296	892	1404	NA	391	333	12	6	4214	417	
Russia	7375	7093	5233	1860	NA	640	590	71	556	9877	68	
Slovenia	2170	2079	765	1314	NA	382	252	0	38	2590	1335	
Spain	10 736	9497	2240	7257	NA	1805	1326	430	1732	75 557	1879	
Sweden	8958	8316	4428	3888	NA	2063	1743	0	0	11 021	1241	
Switzerland	3217	3018	900	2118	NA	2178	1976	0	0	5395	737	
Ukraine	1484	1406	897	509	NA	26	26	0	179	2322	48	
UK	27 673	26 083	14 601	11 482	NA	7083	6238	123	2008	36 887	614	
Argentina	2892	2702	725	1971	6	292	292	0	391	4704	122	
Brazil	7847	7393	1200	6193	0	875	875	0	960	12 218	67	
Chile	808	681	270	393	18	150	150	0	78	1036	66	

Colombia	569	550	224	324	2	48	48	0	184	1736	42
Ecuador	107	90	43	47	0	2	2	0	17	126	9
Guatemala	24	23	12	11	0	0	0	0	0	24	2
Mexico	1388	1336	368	968	0	189	189	0	303	2853	27
Peru	465	353	157	190	6	30	30	0	149	644	23
Dominican Republic	22	20	12	8	0	0	0	0	0	22	3
Uruguay	312	298	116	182	0	21	21	0	9	342	100
Venezuela	844	709	248	461	0	70	70	0	124	1038	42
Bahrain	236	221	91	130	0	61	61	0	0	451	676
Egypt	8020	7709	431	7273	5	697	462	0	0	17 434	233
Jordan	3368	3312	72	3240	0	172	116	0	0	8850	1621
Lebanon	662	622	174	448	0	266	20	0	43	6312	1692
Libya	887	838	0	838	0	0	0	0	0	887	161
Saudi Arabia	887	814	0	814	0	68	24	0	0	6685	275
Syria	306	287	30	257	0	0	0	0	0	306	17
Tunisia	797	779	304	475	0	370	338	0	0	5835	588
UAE	79	79	0	79	0	6	0	0	0	340	137
Israel <sup>†</sup>	NA	16 243	NA	NA	NA	4643	4309	0	0	22 571	3688
Canada	6600	5846	2685	3160	1	1944	1863	0	419	9390	292
USA	85 300	74 048	28 545	45 334	169	15 054	14 598	172	11 862	123,023	424
Total		427 226	178 554	233 550	438	102 816	92 702	3187	21 914	820 286	289
Region <sup>2</sup>											
Asia	47 692	44 909	23 558	21 308	43	8394	7539	735	286	115,713	94
Australia/New Zealand	19 664	17 816	8149	9479	188	12 302	11 431	673	1059	33 698	1425
Europe	265 622	241 107	111 140	129 967	NA	57 162	50 264	1607	6030	444 049	692
Latin America	15 278	14 155	3375	10 748	32	1677	1677	0	2215	24 742	52
Middle East <sup>†</sup>	31 485	29 345	1102	13 554	5	6283	5330	0	43	69 670	463
North America	91 900	79 894	31 230	48 494	170	16 998	16 461	172	12 281	132 413	411

NA, not available; FET, frozen embryo transfer.

<sup>1</sup>Excluding PGD and oocyte donation cycles.

<sup>2</sup>Reported in the registries.

<sup>3</sup>Initiated cycles overall countries estimation: Step 1: cycles in the report = reported numbers for countries reporting them, or estimation by applying their cancellation rate (9.4%) to the aspiration numbers for the not reporting countries. Step 2: total country estimation: 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 countries.

<sup>4</sup>Total estimated number of cycles in the country divided by its population in 2002 (CIA World Factbook).

<sup>†</sup>Israeli data did not separate ICSI and IVF and were not included in the total boxes of IVF and ICSI.

**Table II IVF, ICSI and FET results for 2002**

Country	IVF		ICSI		FET		IVF and ICSI				Total Babies n <sup>a</sup>
	PR/ Asp (%)	DR/ Asp (%)	PR/ Asp (%)	DR/ Asp (%)	PR/ FET (%)	DR/ FET (%)	DR/Asp		Babies/Asp		
							Fresh (%)	Cumul (%)	Fresh (%)	Cumul (%)	
India <sup>†</sup>	NA	NA	NA	NA	18.5	15.0	28.0	29.5	37.2	38.8	2943
Japan	23.3	15.6	18.4	11.9	23.4	15.0	13.8	17.1	17.6	21.6	4793
South Korea	32.5	26.0	30.7	24.2	28.4	22.2	25.2	27.9	29.9	33.0	5089
Australia	25.5	18.8	25.6	20.1	19.6	14.8	19.5	29.4	23.8	35.1	5500
New Zealand	33.8	28.6	36.9	28.8	22.7	17.5	28.7	36.4	36.2	45.4	754
Belgium	37.6	18.6	33.6	16.8	25.3	10.2	17.4	20.1	21.1	24.2	2154
Bulgaria	22.2	9.8	39.0	35.9	17.9	3.6	19.5	19.6	26.3	26.4	210
Croatia	21.6	17.1	23.7	18.9	14.5	13.9	17.8	21.2	22.7	26.4	532
Cyprus	27.8	22.7	28.3	22.6	25.0	16.7	22.7	23.3	27.7	28.5	265
Denmark	28.3	21.0	30.0	23.0	17.2	12.9	21.7	23.6	26.9	29.0	2655
Finland	25.4	20.2	26.2	19.6	20.8	15.0	20.0	29.7	23.1	33.8	1438
France	22.0	16.6	23.4	18.3	14.7	10.7	17.5	20.0	21.1	23.9	11 184
Germany	23.7	14.6	25.9	16.6	17.1	9.9	15.8	18.1	19.6	23.0	14 281
Greece	31.2	18.8	31.3	18.8	28.7	13.4	18.8	19.7	25.7	27.0	1306
Hungary	30.2	24.5	26.5	20.9	15.2	11.7	22.0	22.4	29.1	29.7	1815
Iceland	34.5	28.3	34.8	27.0	31.9	29.2	27.7	35.8	36.5	47.3	123
Ireland (Rep.)	29.6	22.8	29.7	23.6	24.3	18.4	23.1	26.8	29.7	34.4	476
Italy	25.1	20.5	24.7	19.6	20.2	15.7	20.0	22.7	26.5	29.9	3965
Macedonia	21.9	NA	5.2	NA	NA	NA	NA	NA	NA	NA	32
Netherlands	27.4	NA	31.8	NA	21.6	NA	NA	NA	NA	NA	3985
Norway	32.7	26.2	29.3	23.6	17.4	12.2	25.2	25.7	32.6	33.3	1258
Poland	25.5	20.3	29.7	24.2	16.0	12.5	23.2	26.2	28.9	32.4	1055
Portugal	27.2	18.0	25.6	18.3	15.6	7.5	18.2	19.3	23.2	24.4	561
Russia CIS	29.2	14.5	31.3	9.9	21.5	11.7	13.3	14.3	16.6	17.8	1260
Slovenia	30.3	22.1	26.5	20.9	24.6	19.4	21.3	23.7	27.3	30.0	624
Spain	32.7	21.7	35.2	22.5	33.0	21.7	22.3	25.3	30.1	33.9	3215
Sweden	31.0	24.4	29.9	23.8	22.9	15.8	24.1	27.5	28.9	32.6	2712
Switzerland	27.6	19.1	25.8	19.2	17.6	12.7	19.2	27.5	23.2	32.5	980
Ukraine	31.4	23.1	32.8	25.3	19.2	7.7	23.9	24.0	33.8	33.9	477
UK	25.8	22.7	27.5	24.2	18.4	15.6	23.4	27.1	29.5	34.0	8866
Argentina	26.3	20.8	26.4	20.9	22.6	17.1	20.9	22.7	27.4	29.9	976
Brazil	30.8	24.5	31.9	25.3	17.3	12.2	25.2	26.6	34.5	36.2	2923
Chile	34.4	27.8	36.6	30.3	24.0	18.0	29.3	33.3	41.5	46.8	339
Colombia	26.3	21.0	31.5	26.9	14.6	14.6	24.5	25.7	35.0	36.7	280
Ecuador	30.2	25.6	36.2	34.0	NA	NA	30.0	30.0	38.9	38.9	39
Guatemala	16.7	8.3	27.3	27.3	NA	NA	NA	17.4	30.4	30.4	7
Mexico	34.8	28.5	27.1	21.8	14.3	10.1	23.7	25.1	30.8	32.3	541
Peru	30.6	22.3	27.4	20.0	26.7	13.3	21.0	22.2	31.7	33.4	178
Dominican Republic	16.7	8.3	12.5	12.5	NA	NA	10.0	10.0	10.0	10.0	2
Uruguay	37.9	29.3	33.5	25.3	14.3	9.5	26.8	27.5	34.9	35.6	116
Venezuela	37.9	26.6	37.1	28.4	25.7	18.6	27.8	29.6	38.1	40.2	345
Bahrain	20.9	12.1	29.2	11.5	27.9	19.7	11.8	17.2	19.9	25.3	44
Egypt	26.5	20.4	36.4	19.0	16.2	4.5	19.1	19.4	28.0	28.4	2057

Continued

**Table II** *Continued*

Country	IVF		ICSI		FET		IVF and ICSI				Total Babies <i>n</i> <sup>a</sup>
	PR/ Asp (%)	DR/ Asp (%)	PR/ Asp (%)	DR/ Asp (%)	PR/ FET (%)	DR/ FET (%)	DR/Asp		Babies/Asp		
							Fresh (%)	Cumul (%)	Fresh (%)	Cumul (%)	
Jordan	9.7	2.8	16.8	11.0	10.3	6.0	10.8	11.0	15.8	16.2	518
Lebanon	30.5	26.4	32.6	27.7	15.0	10.0	27.3	27.7	32.5	33.1	221
Libya	NA	NA	42.8	39.3	NA	NA	39.3	39.3	46.4	46.4	359
Saudi Arabia	NA	NA	25.2	20.8	25.0	20.8	20.8	21.4	27.5	28.3	224
Syria	13.3	13.3	26.1	17.5	NA	NA	17.1	17.1	21.6	21.6	62
Tunisia	32.2	29.9	33.7	31.4	19.5	18.9	30.8	39.0	48.4	57.3	377
UAE	NA	NA	35.4	30.4	NA	NA	30.4	30.4	48.1	48.1	38
Israel <sup>††</sup>	NA	NA	NA	NA	23.6	21.0	23.9	29.5	NA	NA	6134
Canada	33.9	27.5	33.7	26.6	23.6	18.5	27.0	32.9	37.1	44.6	2291
USA	41.9	34.1	39.4	32.1	31.8	24.9	32.9	37.8	45.9	52.1	45 630
Total <sup>†††</sup>	28.2	22.4	29.2	21.2	21.5	15.3	22.3	25.7	29.9	34.2	148208
Region											
Asia	27.3	24.9	23.0	21.1	24.1	16.8	20.0	22.9	25.1	28.4	12 825
Australia/New Zealand	26.3	19.8	26.6	20.9	19.8	14.9	20.4	30.0	25.0	36.1	6254
Europe	26.0	17.1	27.2	18.5	18.4	12.0	17.9	20.6	23.7	27.0	65 429
Latin America	30.9	24.3	30.8	24.5	18.8	13.7	24.4	26.0	33.3	35.3	5746
Middle East <sup>†††</sup>	26.8	22.0	30.9	19.1	22.4	19.0	21.8	25.0	27.4	28.3	10 034
North America	41.2	33.6	39.0	31.8	30.8	24.2	32.5	37.5	45.2	51.6	47 921

DR; delivery rate, PR: pregnancy rate, Asp: aspiration. 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 (see in the Materials and Methods section). Total babies also includes PGD and OD.

<sup>†</sup>Mixed IVF and ICSI deliveries for India.

<sup>††</sup>ICSI mixed with IVF for Israel.

<sup>†††</sup>Excluding, for IVF and ICSI total rate, Israel and India data.

<sup>a</sup>Estimate from the deliveries number for South Korea, Macedonia, The Netherlands and Israel (see in the text).

applying the average cancellation rate (9.4%) calculated among countries with available data to its number of aspiration cycles. For registries with incomplete coverage, the number of initiated cycles per country was estimated by dividing the reported number by the percentage of participating clinics. A similar estimation was done for the number of ART babies. Finally, the total number of babies born worldwide from 2002 ART procedures was estimated using the hypothesis that the missing countries, mostly in Asia, Africa, Oceania and West Indies, performed between 10% and 20% of the World activity in ART. Availability is expressed as the number of cycles (estimated) per million inhabitants in 2002 (The World Factbook, 2003). A cumulative delivery rate (DR) per aspiration was estimated by adding the FET deliveries to those obtained from fresh cycles and dividing the sum by the number of aspirations.

## Results

Data were received from 1563 clinics in 53 countries (134 clinics and 5 more countries than in 2000). These clinics represented 66% of all registered clinics in those countries, and 27 countries reported a complete coverage (Supplementary Table I). The report covers an estimated total of 601 243 cycles from the participating clinics (+25.6% since 2000). The USA reported the largest number of

aspirations, followed by Germany and France (Table I). On a regional basis, Europe had the largest contribution (56.4%). Overall, FETs represented 21.7% of the aspiration number (14.4% in 2000). This proportion fluctuated from >64% in Finland, Australia and Switzerland to <10% in 23 countries. ICSI represented 56.6% of fertilization procedures (47.6% in 2000), reaching 75.9% in Latin America and 92.4% in the Middle East. The availability of ART varied from two cycles per million inhabitants in Ecuador to 3688 in Israel.

Table II reports the ART outcomes. Pregnancy rates (PRs) and DR per aspiration were very similar in IVF and ICSI (28.2% versus 29.2% and 22.4% versus 21.2%). For FET, PR and DR per transfer were 21.5% and 15.3%. DR increased since 2000 (18.6% for IVF, 20.4% for ICSI and 12.0% for FET). When combining IVF and ICSI, DR per aspiration was 22.3% for the 'fresh' cycles and 25.7% for the cumulative rate (fresh + frozen cycles). Cumulative DR per aspiration varied among countries from 14.3% to 39.3%, being the highest in North America (37.5%). In total, 148 208 babies were reported.

The proportion of women aged 40 years or older was 14.2%, similar to 2000, varying from 2.1% in Croatia to 22.4% in Japan (Supplementary Table II). The DR per aspiration was 9.4% at 40 years or more, and spontaneous miscarriages increased from 28.8% in women <35 years to 43.7% for those ≥40 years (Supplementary Fig. 1).

**Table III** IVF and ICSI cycles: number of transferred embryos, efficacy and safety for 2002

Country	Number of transferred embryos (%)					Efficacy			Multiplicity	
	1	2	3	≥4	Average	PR/Asp (%)	Delivery/Asp (%)	Babies/Asp (%)	Twin (%)	Triplet+ (%)
India	6.7	18.2	37.9	37.2	3.18	34.2	28.0	33.7	19.2	5.9
Japan	21.1	34.2	37.6	7.1	2.32	20.9	13.8	16.7	24.0	1.2
South Korea	9.5	14.3	22.5	53.7	3.41	31.7	25.2	NA	NA	NA
Australia	25.0	68.2	6.3	0.5	1.82	25.5	19.5	21.3	20.7	0.7
New Zealand	9.7	79.4	10.2	0.7	2.02	35.3	28.7	32.8	23.7	1.2
Belgium	16.5	54.3	23.6	5.6	2.18	35.0	17.4	19.2	27.1	0.9
Bulgaria	13.2	20.5	50.9	15.4	2.68	28.5	19.5	24.9	24.5	5.2
Croatia	7.4	89.8	2.8	0.0	1.95	22.4	17.8	22.4	23.5	2.2
Cyprus	10.5	14.3	33.1	42.1	3.07	28.0	22.7	26.1	15.6	3.3
Denmark	18.6	74.5	6.9	0.0	1.88	28.9	21.7	25.5	23.1	0.3
Finland	38.7	59.8	1.5	0.0	1.63	25.7	20.0	22.5	15.2	0.2
France	14.3	53.4	27.7	4.6	2.23	22.7	17.5	18.3	21.0	0.7
Germany	11.0	57.8	31.2	0.0	2.20	25.1	15.8	17.7	21.7	1.2
Greece	16.4	14.8	37.1	31.7	2.84	31.3	18.8	24.5	32.1	2.3
Hungary	11.1	23.7	52.0	13.2	2.67	27.7	22.0	27.3	28.0	2.2
Iceland	23.2	63.7	13.1	0.0	1.90	34.6	27.7	33.1	31.9	0.0
Ireland (Rep.)	6.9	51.9	38.0	3.3	2.38	29.6	23.1	27.1	22.2	3.1
Italy	15.1	35.3	37.7	11.9	2.46	24.9	20.0	22.9	24.0	4.4
Macedonia	20.6	25.8	33.5	20.0	2.53	14.7	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	29.0	NA	NA	NA	NA
Norway	NA	NA	NA	NA	NA	31.3	25.2	31.5	28.9	0.3
Poland	14.8	59.4	23.6	2.3	2.13	28.6	23.2	28.1	22.0	1.3
Portugal	9.9	49.2	35.2	5.7	2.37	26.2	18.2	21.0	23.7	1.9
Russia CIS	13.5	31.8	33.7	21.0	2.62	29.7	13.3	16.0	19.8	2.5
Slovenia	25.7	63.3	11.0	0.0	1.85	27.9	21.3	26.1	24.4	1.8
Spain	11.5	32.3	44.5	11.6	2.56	34.6	22.3	26.6	27.6	3.6
Sweden	30.6	68.9	0.5	0.0	1.70	30.5	24.1	26.8	19.2	0.2
Switzerland	11.7	63.0	25.2	0.0	2.14	26.3	19.2	21.8	19.4	0.9
Ukraine	10.1	25.0	35.3	29.5	2.84	31.9	23.9	32.0	36.0	2.7
UK	7.9	77.5	14.6	0.0	2.07	26.6	23.4	27.8	25.2	0.6
Argentina	16.7	25.1	36.6	21.6	2.68	26.4	20.9	25.3	22.3	4.1
Brazil	7.2	16.6	29.3	46.9	3.30	31.7	25.2	32.3	26.5	7.7
Chile	8.0	32.2	42.8	17.0	2.70	35.7	29.3	33.9	26.3	7.3
Colombia	11.9	18.8	33.7	35.6	3.06	29.4	24.5	33.6	29.1	6.7
Ecuador	10.7	17.3	32.0	40.0	3.08	33.3	30.0	32.7	22.2	3.7
Guatemala	21.1	21.1	36.7	21.1	2.68	21.7	17.4	29.2	25.0	25.0
Mexico	7.8	15.7	31.5	45.0	3.27	29.2	23.7	29.4	17.8	6.1
Peru	6.9	24.6	41.4	27.1	2.94	28.8	21.0	23.0	29.2	9.7
Dominican Republic	33.3	20.0	20.0	26.7	2.47	15.0	10.0	9.1	0.0	0.0
Uruguay	12.4	21.5	32.7	33.4	2.93	35.2	26.8	33.3	20.0	5.0
Venezuela	6.1	24.8	45.9	23.2	2.89	37.4	27.8	31.9	27.4	4.6
Bahrain	11.7	25.5	18.8	44.0	3.31	25.8	11.8	18.6	10.5	2.6
Egypt	9.2	19.0	48.2	23.6	2.97	35.8	19.1	25.6	26.1	6.0
Jordan	14.2	18.1	25.4	42.3	3.07	16.6	10.8	15.4	28.8	6.6
Lebanon	18.6	50.3	28.5	2.6	2.15	32.0	27.3	30.5	15.1	1.2

Continued

**Table III** *Continued*

Country	Number of transferred embryos (%)					Efficacy			Multiplicity	
	1	2	3	≥4	Average	PR/Asp (%)	Delivery/Asp (%)	Babies/Asp (%)	Twin (%)	Triplet+ (%)
Libya	11.9	70.9	17.2	0.0	2.05	42.8	39.3	40.5	6.1	1.5
Saudi Arabia	3.3	53.6	29.3	13.8	2.58	25.2	20.8	25.3	18.4	5.2
Syria	16.7	20.2	15.1	48.1	3.28	24.7	17.1	20.3	22.4	2.0
Tunisia	4.0	33.0	43.8	19.2	2.79	33.1	30.8	47.3	19.4	2.3
UAE	10.3	20.5	32.1	37.2	3.00	35.4	30.4	48.1	33.3	12.5
Israel	NA	NA	NA	NA	NA	26.2	23.9	NA	NA	NA
Canada	8.3	51.8	30.3	9.6	2.43	33.8	27.0	32.8	31.9	2.7
USA	6.7	31.9	33.7	27.7	2.92	40.3	32.9	39.7	31.7	3.8
Total	12.4	45.2	28.6	13.7	2.47	30.5	22.3	23.2	25.7	2.5
Region										
Asia	14.1	23.8	32.3	29.7	2.88	26.8	20.0	21.2	22.0	3.1
Australia/New Zealand	23.5	69.3	6.7	0.5	1.84	26.5	20.4	22.4	21.1	0.8
Europe	13.7	54.8	26.9	4.7	2.23	26.7	17.9	20.3	23.2	1.3
Latin America	9.4	19.7	33.0	37.9	3.10	30.8	24.4	30.5	25.0	6.7
Middle East	10.4	26.4	38.0	25.2	2.88	28.3	21.8	25.5	22.2	4.8
North America	6.8	33.3	33.5	26.4	2.89	39.9	32.5	39.2	31.7	3.7

The percentage of transfers with four or more embryos decreased since 2000 from 15.4% to 13.7% (Table III) in fresh cycles, remaining high in South Korea (53.7%), Latin America (37.9%), India (37.2%) and UAE (37.2%), but low (0–0.5%) in 11 countries in Europe and Australia. The proportion of single embryo transfers increased from 10.5% to 12.4%, highest in Finland (38.5%), Sweden (30.5%) and Australia (25.0%). Overall, the proportions of twin and of triplet pregnancies decreased since 2000 (from 26.5% to 25.7% and from 2.9% to 2.5%). The triplet DR varied markedly, from 0.2% in Finland and Sweden to >10% in Guatemala and UAE. The mean number of embryos transferred (Supplementary Fig. 2) was correlated with the triplet rate ( $r = 0.48$ ,  $P < 0.001$ ), but not with DR ( $r = 0.02$ , NS). The same developments were seen for FET, with a lower rate of multiple pregnancies (Supplementary Table III). The percentage of premature babies (<37 weeks) increased from 13.5% for singletons to 61.3% for twins and 94.2% for triplets (Supplementary Fig. 3). The same was true for perinatal mortality (10.7, 29.6 and 71.2 per 1000 babies) (Table IV).

The abortion rate per clinical pregnancy was, on average, 20.0% in fresh cycles, with large differences (2.4–47.3%), and higher in FET pregnancies (25.2%,  $P < 0.001$ ).

Only 14 countries reported 3187 PGD cycles with PR and DR per aspiration at 23.0% and 17.6% (Supplementary Table IV). Furthermore, 31 countries reported OD (Supplementary Table V). Out of 21 914 OD transfers, 54.1% were done in the USA and 70.8% were fresh embryos transfers. For fresh transfers, PR and DR per transfer were 52.1% and 39.1%. For OD-FET, PR per transfer was lower (30.5%). The total number of reported babies was 10 108 (8800 in USA). Europe reported 2174 pregnancies but not the deliveries and births.

The frequency of ovarian hyperstimulation syndrome was reported by 34 countries, at 0.8% (range 0.3%–6.6%). Congenital anomalies were poorly reported (Supplementary Table VI).

Finally, taking into account the missing centres, it was estimated that ART produced 196 981 babies from 820 280 cycles in the participating countries. By extrapolation, it was estimated that 219 000–246 000 babies were born worldwide from an estimated 911 000 to 1 025 000 cycles, an increase of 12% compared with the year 2000.

## Discussion

The ICMART World report gives a broad overview of the World ART practice and results for 2002, even though there are some methodological problems (Cohen, 2001).

### Methodological problems

Several large countries did not report data: China, Pakistan, Bangladesh, Indonesia, Philippines, Turkey and all of sub-Saharan Africa. Also, one-third of the clinics in the participating countries did not report to their national registers. We hypothesized that ART was less frequent in the missing countries and would contribute 10–20% of the world ART activity, and that missing clinics had the same level of activity and results as the reporting clinics, which can be debated. With these assumptions, it can be estimated that this report would cover 60–70% of the World ART activity. ICMART is continuing efforts to improve data collection, and it is encouraging that 27 countries had a complete reporting from all clinics.

Many countries submitted incomplete data, mostly due to the pyramidal organization of data collection: data were exported from clinics

**Table IV** Pregnancy losses, prematurity and perinatal mortality for 2002

Country	Aspiration cycles (IVF and ICSI)					FET cycles				
	Pregnancies			Deliveries		Pregnancies			Deliveries	
	Reported (n)	Outcome* (n)	Losses (%)	Preterm (%)	Mortality (p1000)	Reported (n)	Outcome* (n)	Losses (%)	Preterm (%)	Mortality (p1000)
India	2592	2126	NA	NA	NA	137	111	NA	NA	NA
Japan	4626	4170	26.0	19.8	12.0	1153	1013	27.3	19.4	9.0
South Korea	4792	NA	NA	NA	NA	530	NA	NA	NA	NA
Australia	4065	3222	3.8	21.4	11.2	2092	1177	4.3	18.0	7.3
New Zealand	602	501	2.4	25.1	17.9	170	136	3.7	28.3	6.5
Belgium	3111	2130	27.3	NA	NA	595	418	42.8	NA	NA
Bulgaria	226	201	22.9	NA	NA	5	2	50.0	NA	NA
Croatia	451	415	13.7	NA	NA	72	75	8.0	NA	NA
Cyprus	261	261	19.2	NA	NA	9	3	100.0	NA	NA
Denmark	2648	2469	19.4	NA	NA	224	218	22.9	NA	NA
Finland	1091	1085	21.8	NA	NA	572	561	26.6	NA	NA
France	10 632	10 632	23.0	NA	NA	1613	1612	27.1	NA	NA
Germany	15 569	12 994	24.4	NA	NA	2433	2013	30.3	NA	NA
Greece	1514	1132	19.5	NA	NA	94	65	32.3	NA	NA
Hungary	1694	1651	18.5	NA	NA	35	34	20.6	NA	NA
Iceland	90	90	20.0	NA	NA	23	23	8.7	NA	NA
Ireland (Rep.)	410	410	22.0	NA	NA	66	66	24.2	NA	NA
Italy	3295	3163	16.3	NA	NA	459	444	19.6	NA	NA
Macedonia	33	NA	NA	NA	NA	0	0	NA	NA	NA
Netherlands	3851	NA	NA	NA	NA	317	NA	NA	NA	NA
Norway	1185	1185	19.7	NA	NA	30	30	30.0	NA	NA
Poland	931	878	13.9	NA	NA	125	125	21.6	NA	NA
Portugal	602	527	20.7	NA	NA	52	49	49.0	NA	NA
Russia CIS	2109	1316	28.3	NA	NA	127	92	25.0	NA	NA
Slovenia	580	536	17.4	NA	NA	62	58	15.5	NA	NA
Spain	3284	2671	20.7	NA	NA	437	393	26.7	NA	NA
Sweden	2534	2534	20.8	NA	NA	400	400	31.0	NA	NA
Switzerland	794	753	23.2	NA	NA	348	338	25.7	NA	NA
Ukraine	449	404	16.8	NA	NA	5	5	60.0	NA	NA
UK	6933	6753	9.8	NA	NA	1149	1108	12.0	NA	NA
Argentina	711	711	20.8	21.9	25.7	66	66	24.2	17.8	0.0
Brazil	2346	2346	20.7	29.7	39.2	151	151	29.1	14.4	32.0
Chile	237	237	18.1	27.4	10.9	36	36	25.0	23.1	0.0



Colombia	161	161	16.8	35.9	26.0	7	7	0.0	100.0	0.0
Ecuador	30	30	10.0	30.8	29.4	0	NA	NA	NA	NA
Guatemala	5	5	20.0	25.0	0.0	0	NA	NA	NA	NA
Mexico	390	390	19.0	28.2	31.9	27	27	29.6	12.5	0.0
Peru	100	100	27.0	44.8	46.3	8	8	50.0	100.0	0.0
Dominican Republic	3	3	33.3	NA	0.0	0	0	NA	NA	NA
Uruguay	105	105	23.8	32.5	9.6	3	3	33.3	0.0	0.0
Venezuela	265	265	25.7	27.5	18.5	18	18	27.8	16.7	133.3
Bahrain	57	74	48.6	NA	0.0	17	NA	NA	NA	0.0
Egypt	2758	2835	NA	33.5	NA	75	NA	NA	33.3	NA
Jordan	550	562	35.1	66.4	36.7	12	NA	NA	80.0	0.0
Lebanon	199	202	14.9	21.8	76.6	3	NA	NA	50.0	69.3
Libya	359	359	8.4	40.7	22.3	0	NA	NA	NA	NA
Saudi Arabia	205	211	17.5	27.8	41.4	6	NA	NA	40.0	0.0
Syria	71	71	31.0	NA	0.0	0	NA	NA	NA	NA
Tunisia	258	324	6.2	7.9	46.7	66	NA	NA	15.6	0.0
UAE	28	28	14.3	NA	0.0	0	NA	NA	NA	NA
Israel	4256	2991	NA	NA	NA	1016	743	NA	NA	NA
Canada	1976	1884	16.5	34.1	30.0	440	434	20.7	39.1	27.8
USA	29 799	29 559	17.7	32.0	21.3	4638	4588	20.7	36.5	23.6
Total	125 823	107 662	20.0	30.3	25.4	19 923	9445	25.2	28.2	23.6
Region										
Asia	12 010	6296	26.0	21.5	NA	1820	1124	27.3	19.4	16.8
Australia/New Zealand	4667	3723	3.6	21.9	12.1	2262	1313	4.3	18.8	16.2
Europe	64 277	54 190	20.5	NA	NA	9252	8132	26.0	NA	NA
Latin America	4353	4353	20.7	28.6	32.4	316	316	27.5	23.6	20.0
Middle East	8741	4666	36.8	35.0	73.5	1195	NA	NA	25.5	25.3
North America	31 775	31 443	17.7	32.2	21.9	5078	5022	20.7	36.8	27.9

NA, not available.

\*Outcome = pregnancy outcome documented; preterm: <37 weeks; mortality = perinatal mortality, sum of stillbirths  $\geq 20$  weeks of gestation and of neonatal deaths up to 7 completed days of life (for live births  $\geq 20$  weeks of gestation) pregnancy losses = sum of spontaneous miscarriages, pregnancy terminations (generally for congenital anomaly) and ectopic pregnancies.

to countries, then to regions and then to ICMART. This allowed each clinic to complete forms only once, but complicated efforts to develop a common standardized data form at the different collection levels. However, the major outcome variables (procedures, pregnancies, deliveries and babies) are the same in all the registries.

Moreover, the ICMART-WHO glossary definitions (ICMART *et al.*, 2002, Zegers-Hochschild *et al.*, 2006a, b) are likely not always utilized, even though the glossary has been endorsed by most large international professional organizations. One illustration is the wide variation in abortion rates among the countries (2.4–47.3%), far too large to be explained only by chance. This reinforces the necessity of encouraging all professionals to utilize the glossary and to report DR per cycle initiated (intention to treat) or at least per aspiration.

Thus, variation in data quality, added to differences in practices, legislation, guidelines, culture and religion, means that comparisons among countries must be done with caution. However, it is far better to have imperfect but improvable data than no data at all (Adamson *et al.*, 2001). Large differences can be identified, explored in specific studies and time-trends followed.

## Trends and general considerations

This report shows a continuous increase in the number of aspirations in participating countries (+16.0% since 2000). There are wide differences in availability, with many potential reasons such as fertility rate, women's age, insurance coverage, national economy etc., but the most important is certainly inequality in the access to healthcare and ART.

The use of ICSI is increasing worldwide (from 54.4% in 2000 to 60.8% in 2002 in North America, from 45.7% to 53.9% in Europe), and reached 76.1% in Latin America and 92.5% in Middle East in 2002. Since there is no reason to believe that there is such an increase in male infertility, the reasons behind this trend are difficult to know, since ICSI has not been demonstrated to improve results for non-male infertility treatment.

One of the major public health problems in ART is the high rate of multiple births, with serious consequences for both maternal and newborn health. It is encouraging to note a decrease in the mean number of transferred embryos and multiple birth rate in almost all countries. However, as one triplet pregnancy results in three triplet babies, this means that 14.6% of ART babies were triplet in Latin America, 10.9% in the Middle East (two regions where no embryo reduction is available), 8.2% in the USA, 3.1% in Europe and 2.0% in ANZ. The fact that the average number of transferred embryos was not related to PR, after more than two are transferred, that the average number of embryos transferred was reduced and that DR per aspiration was increased in 2002 should encourage embryo transfer policies that reduce the risk of multiple birth.

Another benefit of lowering the number of embryos transferred fresh is that it results in more embryos available for freezing and more FET, probably explaining the major FET increase reported in 2002 (+47%). To better evaluate ART results, it is necessary to use a cumulative PR, adding to the fresh pregnancies the additional FET pregnancies resulting from the same aspiration. The ICMART cumulative rate is not methodologically perfectly correct, since we sum the fresh and frozen pregnancies of the same year, whether they come from the same aspiration or not. This calculation approximates the

correct result if the proportions of aspirations and FET remain constant over time, but may slightly underestimate the actual rate if there is a relative increase in FET. Even imperfect, it is currently the only way to approximate the actual results of aspirations since FET can be performed several years later. This calculation is of major importance to compare countries or centres. For example, in Australia, the DR per aspiration was at 19.5% for fresh cycles and at 29.4% for the cumulative rate (mean number of transferred embryos 1.8), whereas the gain was less in Latin America (24.4–26.0%, 3.1 embryos transferred).

Maternal complications and congenital anomalies were poorly reported, due to the lack of standardized terminology and diagnosis, to the sometimes high rate of loss to follow-up and also because a certain proportion of anomalies are not discovered until after the time covered by the reporting period. Therefore, data on birth defects need other data collection strategies.

## Conclusion

This World Report shows a general increase in ART activity over time. PR and DR have increased despite a decrease in the number of embryos transferred, accompanied by a decrease in the percentage of multiple pregnancies. There are still large differences among countries. Europe and ANZ continue to lead the way in the reduction of multiples with triplet rates approximately half those of the USA and 5-fold less than Latin America, whereas the USA continues to have the highest PRs. Consistent with a decrease in the number of embryos transferred, the proportion of FET is increasing 2-fold faster than oocyte aspiration cycles. From this report, the total number of babies born through ART worldwide in the year 2002 is estimated to be between 219 000 and 246 000.

## List of contributors

Australian and New Zealand Assisted Reproduction Database (ANZARD), Fertility Society of Australia/AIHW National Perinatal Statistics Unit, European IVF Monitoring (EIM) Consortium, Latin American Network for Reproductive Medicine (RED), Society for Assisted Reproductive Technology (SART)/Centres for Disease Control (CDC), Middle East IVF registry and all the participating countries (ART centres participating in the ICMART 2000 World Report are listed in Supplementary data).

## Supplementary data

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

## Funding

ICMART receives financial support from the following organizations: American Society for Reproductive Medicine (ASRM), Bertarelli Foundation, European Society for Human Reproduction and Embryology (ESHRE), Fertility Society of Australia (FSA), Latin American Network for Reproductive Medicine (RED), Middle East Fertility Society (MEFS) and Society for Assisted Reproductive Technology (SART).

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- Submitted on May 31, 2008; resubmitted on January 14, 2009; accepted on March 5, 2009*