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Assisted reproductive technologies in Africa: first results from the African Network and Registry for Assisted Reproductive Technology, 2013

BIOGRAPHY

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KEY MESSAGE

This paper presents the first findings from the African Network and Registry for Assisted Reproductive Technology, incorporating data from 40 centres in 13 countries. Results pertaining to availability, utilization and outcomes of ART are presented and provide a basis for assessing ART standards in Africa.

ABSTRACT

Research question: What were utilization, outcomes and practices in assisted reproductive technology (ART) in Africa in 2013?

Design: To initiate a data registry in Africa, retrospective summary data were collected in a cross-sectional survey.

Results: Forty ART centres from 13 countries collectively reported 25,770 initiated cycles. Regional ART utilization could not be established due to large inter-country variations and insufficient data. The pregnancy rate per aspiration for fresh non-donor IVF and intracytoplasmic sperm injection was 28.0% and 35.8%, with a preponderance of women under 35 years (57.3%). Deliveries were reported for only 56.1% of pregnancies; the remainder were lost to follow-up. A mean of 2.41 embryos were transferred. The multiple delivery rate was 26.7% (25.5% twins and 1.2% triplets). Most twins (52.7%) and triplets (73.7%) were born pre-term. Oocyte donation represented 7% of all fresh and frozen transfers.

Conclusion: This marks the beginning of an ART registry in Africa, Since ART utilization could not be established, the degree of access to ART remains speculative. Pregnancy rates were favourable but underpinned by a preponderance of young women and the transfer of multiple embryos. Efforts are needed to explore treatment barriers, improve pregnancy follow-up and reduce the high rate of multiples. This inaugural report from the African Network and Registry for Assisted Reproductive Technology (ANARA) indicates a willingness and ability of ART centres to voluntarily report and monitor utilization and outcomes of ART, which reflects a rising standard of ART in Africa. It is anticipated that more centres and countries will join ANARA to continue this trend.

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KEYWORDS

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INTRODUCTION

Despite Africa's early participation in the globalization of assisted reproductive technology (ART), subsequent expansion has been slow compared with other world regions (*Inhorn and Patrizio, 2015*). According to the latest World Report of the International Committee Monitoring Assisted Reproductive Technologies (ICMART), sub-Saharan Africa had the lowest rate of ART utilization in 2011, reporting 71 cycles/million population/annum. This compares to the global average of 477 cycles/million population and to 1500 cycles/million population/annum estimated to meet the demand for ART (*Adamson et al., 2018; ESHRE Capri Workshop Group, 2001*).

ART utilization is one of the very few proxy markers for access to infertility care. A low rate of ART utilization is hence concerning as it is in stark contrast to the high burden of infertility in Africa. There are many reasons for this mismatch, relating to what continues to drive infertility disease and its many negative consequences, and what prevents better access to care. Finding solutions is challenging but not impossible. Different strategies are needed for the various drivers and barriers, but they all benefit from data documenting availability, utilization, effectiveness and safety of ART. Until now, these data have largely been lacking because for a quarter century Africa has lagged behind other world regions that established registries to monitor trends and outcomes of ART, and to report on these indicators annually (*Botha et al., 2018*).

In recognition of the central importance of data to the cause of ART – and through ART to the reproductive health of people in Africa – the African Network and Registry for Assisted Reproductive Technology (ANARA) was created. ANARA is a research network and registry that has evolved over the last 3 years under the umbrella of ICMART. It is modelled on the Latin American Registry of Assisted Reproduction, from which it received developmental assistance including donation of its software. According to this model, participating ART centres submit their data online to the Registry, which pools and analyses the data and then reports back to each centre confidentially their own data, plus the national data to each country, and regional data to the region. Participation is free of charge. The anonymity of participating centres and patients is protected as ANARA only collects de-identified patient information and does not disclose results of individual centres. ANARA engaged with and was subsequently endorsed by the African Fertility Society, the Groupe Interafricain d'Etude, de Recherche et d'Application sur la Fertilité (the regional fertility society in Francophone Africa), as well as national fertility organizations in Egypt, Ghana, Nigeria and South Africa. To date multiple avenues are being pursued to build capacity for data collection (https://www.anara-africa.com).

This paper presents the first registry data collected in 2017 pertaining to ART cycles initiated in 2013.

MATERIALS AND METHODS

Data collection

Since the 2013 data preceded the existence of ANARA and its software, data were collected through different methods and pathways: all countries except Ghana and Nigeria submitted data using the ICMART data collection forms. Centres from Ghana and Nigeria sent data in various largely centre-specific formats, which were then transferred to the ICMART format. Egypt, Ghana, Nigeria, Mauritius, Senegal and South Africa submitted their data directly to ANARA. The Francophone African countries (Benin, Cameroon, Ivory Coast, Mali and Togo), as well as Morocco and Tunisia, reported simultaneously to ICMART and ANARA.

Data processing

Data were processed in Microsoft Excel®. Most countries could not comply with the extent of information requested by ANARA. The greatest difficulty was the stratification of data by standard age groups and number of embryos transferred. Also, of 8206 clinical pregnancies reported after non-donor and donor fresh and frozen cycles, only 4600 (56.1%) had information pertaining to deliveries.

Data were accepted at face value unless there were mathematical errors. Where possible these were resolved by contacting the ART centre. The remaining data errors were managed by checking consistency across the data set and then eliminating the most likely error, or by discarding the subset of data containing the error. Data from one centre had to be excluded because of data incompatibility.

Country data were pooled to calculate totals for the region. With the exception of participation and overall number of procedures (TABLE 1), ANARA does not compare country data and results are presented as regional data only. ART utilization was calculated as the ratio of all initiated cycles conducted by participating centres over total population in millions. Where indicated, the t-test was used to compare findings; however, as this is the first regional report and the extent and quality of the data are still inconsistent, it was decided to concentrate on descriptive analysis rather than complex statistical calculations with as yet limited clinical correlation.

ANARA is registered with the Human Research Ethics Committee of the Faculty of Health Sciences, University of Cape Town. Any further relevant approvals were obtained at country level.

RESULTS

Participation

Data were received from 40 centres in 13 countries. The participation rate was 19.1% (range 5.1–100%; TABLE 1). Eight centres conducted <200 cycles; eight centres between 200 and 499 cycles; six centres between 500 and 999 cycles; and two centres performed >1000 cycles (missing data, n = 16).

As mentioned, not all countries, and not all centres in one country, reported on all indicators. As a result, the number of procedures and outcomes were not consistent across different tables.

Number of procedures and utilization

In 2013, 25,770 ART cycles were initiated (TABLE 1). Specifically, 19,207 non-donor aspirations with 17,122 fresh embryo transfers were performed. Fertilization by intracytoplasmic sperm injection (ICSI) occurred in 89.2% of aspirations. Analysed by country, the mean ICSI rate was 72.0% with a median rate of 83.7%. There were 329 'freeze all' aspirations reported and 3560 frozen embryo transfers (FET). The proportion of fresh embryo transfers over all fresh and frozen transfers was 82.8%.

TABLE 1 NUMBER OF CENTRES, PROCEDURES AND ART UTILIZATION

Country	Centres total[a] (*n*)	Participating centres (*n*)	Participation rate (%)	IVF asp. (*n*)	ICSI asp. (*n*)	FET (*n*)	OD transfer cycles (*n*)	OD FET (*n*)	PGT (*n*)	Procedures total (*n*)	Initiated cycles total (*n*)[c]	Utilization[d,*]
Benin	1	1	100.0	5	81	NA	17			103	121	13*
Cameroon	2	1	50.0	106	12	3	27	3		151	171	8
Egypt	98	5	5.1	3	9157	2137			10	11,307	11,996	142
Ghana	10	2	20.0	NA[b]	134[b]	14				148	155	6
Ivory Coast	1	1	100.0	77	0	NA	162			239	243	12*
Mali	1	1	100.0	26	103	31				160	191	12*
Mauritius	3	1	33.3	40	86	62				188	194	149
Morocco	18	1	5.6	86	466	135				687	727	22
Nigeria	40	9	22.5	285	1384	174	765	41	13	2662	2775	16
Senegal	1	1	100.0	0	61	NA				61	64	5*
South Africa	20	14	70.0	1092	2261	431	416	72		4272	4368	82
Togo	2	1	50.0	15	98	7	47			167	217	35
Tunisia	12	2	16.7	341	3288	566				4195	4408	404
Total	209	40	19.1	2076	17,131	3560	1434	116	23	24,340	25,770	55

ART = assisted reproductive technologies; asp. = aspiration; FET = frozen embryo transfer; ICSI = intracytoplasmic sperm injection; NA = not available; OD = oocyte donation; PGT = preimplantation genetic testing.

[a] Number of centres reported to exist.

[b] IVF asp. reported together with ICSI.

[c] Initiated cycles total: sum of all initiated cycles (all fresh and frozen cycles conducted by participating ART centres) for countries reporting these, or estimation by applying their cancellation rate to number of aspirations and thawings for the countries not reporting initiated cycles.

[d] Total initiated cycles conducted by participating centres divided by size of population in 2013 (CIA World Fact Book). Numbers with asterisks represent true utilization in countries with 100% registry participation.

TABLE 2 CLINICAL PREGNANCY RATE AND DELIVERY RATE BY TYPE OF PROCEDURE

Procedure type	IVF[a]	ICSI[a]	FET[a]	Fresh OD
Aspirations	2076	17,131		742
Transfers	1757	15,365	3560	1434
Pregnancies	581	6125	984	479
Deliveries	205	3666	605	121
PR/asp. (%)	28.0	35.8		
PR/ET (%)	33.1	39.9	27.6	33.4
DR/asp. (%)	9.9	21.4		
DR/ET (%)	11.7	23.9	17.0	8.4

asp. = aspiration; DR = delivery rate; ET = embryo transfer; FET = frozen embryo transfer; ICSI = intracytoplasmic sperm injection; OD = oocyte donation; PR = pregnancy rate.
[a] Refers to non-donor procedures.

Oocyte donation, reported from six countries (Benin, Cameroon, Ivory Coast, Nigeria, South Africa and Togo), resulted in 1550 fresh and frozen embryo transfers. Proportionally, this amounted to 7.0% of all donor and non-donor embryo transfers (n = 22,232). Scant data pertaining to preimplantation genetic testing (PGT) and donor FET (TABLE 1), as well as intrauterine insemination cycles with donor sperm (n = 54; 4 countries), were received and not further analysed.

The number of initiated cycles versus population size in 2013 is captured in TABLE 1. With the exception of a few countries with single centres, true ART utilization, that is number of all ART cycles performed in a country per million population per year, could not be established due to insufficient participation. ART utilization based only on reported procedures averaged at 55 cycles/million population (range 5–404 cycles/million population; TABLE 1).

Effectiveness

All pregnancies reported were clinical pregnancies. Many centres and countries did not report on deliveries, hence the following results show a greater discrepancy between pregnancy rates and delivery rates than otherwise expected.

The pregnancy rates and delivery rates by type of procedure are presented in TABLE 2. In non-donor cycles, ICSI was associated with higher pregnancy rates and delivery rates when compared with IVF ($P < 0.05$). Together, both fertilization methods resulted in a pregnancy rate per aspiration of 34.9%, with a corresponding delivery rate of 20.2%. Following FET, the pregnancy rate was 27.6% with a delivery rate of 17.0%.

These findings were further influenced by age, as expected (TABLE 3). Following 18,712 aspirations in women of all ages, the fresh pregnancy rate and delivery rate per aspiration dropped from 39.6% and 23.8% in women ≤34 years to 20.5% and 7.4% in women ≥40 years. The distribution of procedures and pregnancies by age is captured in FIGURE 1. The majority of aspirations were reported in women ≤34 years old (57.3%). This age category also comprised 66.2% of all pregnancies and 70.9% of deliveries. In FET cycles, there was an even greater preponderance of young women, accounting for two-thirds of procedures and three-quarters of pregnancies (TABLE 3).

Against a backdrop of many cultural and religious influences, fresh embryo transfers following oocyte donation were reported by six countries with an overall clinical pregnancy rate of 33.4%. Delivery rates could not be established due to poor follow-up. The majority of embryo transfers (75.1%) were performed in women ≥40 years.

Safety

The outcome after non-donor IVF/ICSI stratified by number of fresh embryos transferred is captured in TABLE 4 (missing

TABLE 3 NON-DONOR IVF, ICSI AND FET: RESULTS BY WOMEN'S AGE

	Fresh IVF and ICSI[a]			FET[b]		
	Age ≤34	Age 35–39	Age ≥40	Age ≤34	Age 35–39	Age ≥40
Aspirations, *n* (%)	10,722 (57.3)	5208 (27.8)	2782 (14.9)	–	–	–
Thaws or transfers, *n* (%)[c]	–	–	–	2349 (67.0)	896 (25.5)	262 (7.5)
Clinical pregnancies, *n* (%)	4246 (66.2)	1597 (24.9)	570 (8.9)	666 (73.5)	186 (20.5)	54 (6.0)
Deliveries, *n* (%)	2547 (70.9)	837 (23.3)	207 (5.8)	410 (75.4)	116 (21.3)	18 (3.3)
PR/asp. (%)	39.6	30.7	20.5	28.4	20.8	20.6
DR/asp. (%)	23.8	16.1	7.4	17.5	12.9	6.9

asp. = aspiration; DR = delivery rate; FET = frozen embryo transfer; ICSI = intracytoplasmic sperm injection; PR = pregnancy rate.
[a] Data not reported from Benin, Ghana, Senegal and from five centres in Nigeria and South Africa.
[b] Data not reported from Benin, Ghana, Ivory Coast, Morocco, Mauritius, Senegal, South Africa.
[c] Thaws only reported from Egypt and transfers only reported from the other countries.

data from Benin, Mali, Mauritius and Senegal). In 16,803 cycles, the mean number of embryos transferred was 2.41. The majority of transfers involved two (41.2%) or three embryos (35.4%). Single-embryo transfer (SET) was only slightly more frequent than the transfer of four or more embryos (13.6% versus 9.8%). The pregnancy rate per embryo transfer following double-embryo transfer (DET) was higher when compared with SET (42.2% versus 23.0%) but then dropped slightly with the transfer of more embryos. The mean percentage of twin and triplet deliveries was 25.5% and 1.2%, respectively, ranging from 0.3% and 0.0% after SET to 36.0% and 8.3% with the transfer of four or more embryos (TABLE 4).

The majority of FET after non-donor IVF/ICSI similarly involved two (36.9%) or three embryos (40.1%); and transfers with four or more embryos (14.1%) outweighed SET (8.8%). The mean number of embryos transferred was 2.61 with a resultant multiple delivery rate of 24.6%.

Data on gestational age after fresh non-donor IVF/ICSI are displayed in FIGURE 2, demonstrating the high rate of pre-term deliveries among multiples. These deliveries (n = 3060), reported from five countries, are missing information from 1323 deliveries with unknown number of babies or gestational age. After FET, 48.5% of multiples were similarly delivered pre-term compared with 16.4% of singletons.

Only Egypt, Nigeria and Tunisia provided data on the health status of neonates after fresh IVF/ICSI. Among 3776 babies born, 40.3% were multiples. The combined percentage of stillbirths and neonatal deaths was 2.8% among singletons, 6.7% among twins and 16.7% among triplets. The rate of unknown health status was again disproportionally high for multiples when compared with singletons (42.6% versus 7.2%).

After oocyte donation, the mean number of fresh embryos transferred was 2.54, similar to non-donation cycles. The rate of multiples was 28.9%, but this is based on only 121 reported deliveries.

Intrauterine insemination

Following 2753 intrauterine insemination cycles with husband/partner sperm, reported by nine countries, the mean pregnancy rate and delivery rate per cycle was 19.2% and 10.5%, respectively. The pregnancy rate per cycle was 20.4% for women ≤34 years, 18.5% for women aged 35–39 years, and 12.0% for women ≥40 years. The delivery rates were 11.0%, 9.6% and 9.6%, respectively. The multiple delivery rate was 6.5% and involved twins only. Missing information included 44 cycles without outcome data and 198 cycles in which pregnancies but not deliveries were reported.

DISCUSSION

Results pertaining to ART in Africa have been previously published as part of the ICMART World Report, the IFFS surveillance and in the form of a few reviews (*Botha et al., 2018; Dyer et al., 2016; Gerrits and Shaw, 2010; Giwa-Osagie, 2002; Inhorn and Patrizio, 2015; Ory et al., 2016*). This manuscript contributes to the existing literature as the first stand-alone and largest report documenting ART utilization, effectiveness and safety in Africa. It is the result of a relatively short but fruitful engagement between ANARA and ART centres in Africa; and between ANARA and local fertility societies, the Latin American ART Registry, and ICMART. Data collection relies on appropriate methodology and appropriate software. Although both are now in place for the future, this report, which deals with cycles initiated in 2013, lacks the robustness we expect for future reports. Therefore, this discussion is focused on the interpretation, strengths and limitations of findings without attempting scientific comparison with other registry

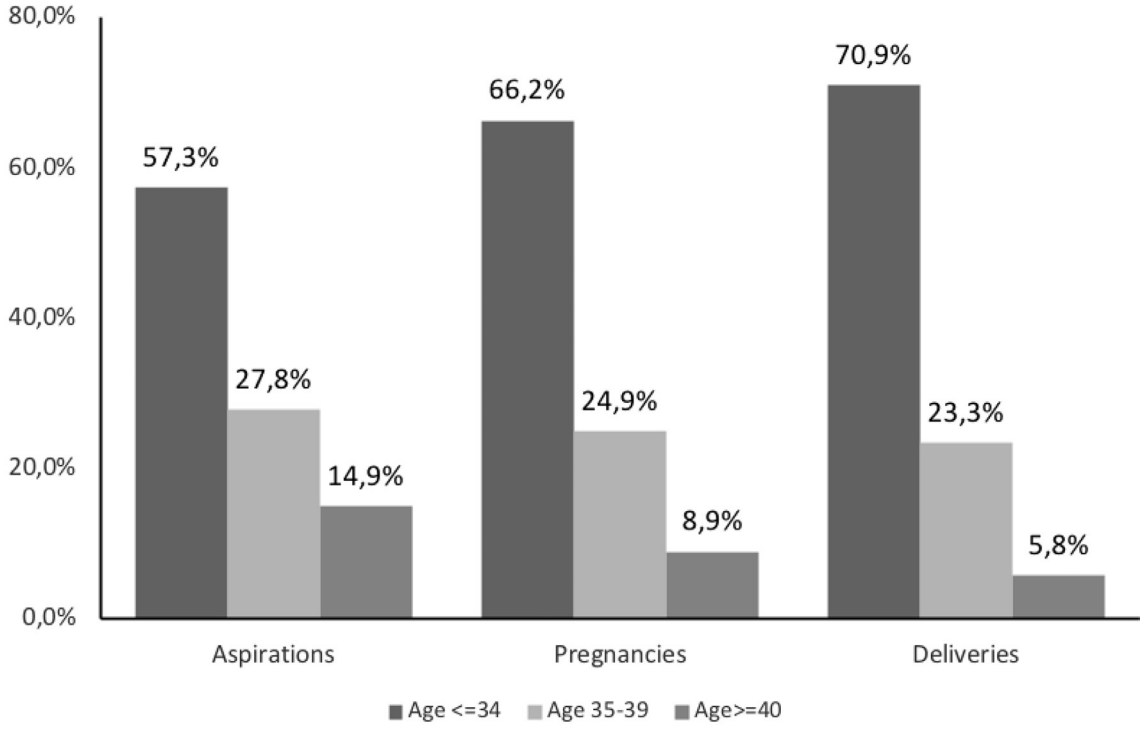

FIGURE 1 Non-donor fresh IVF and ICSI: results by women's age.

TABLE 4 FRESH NON-DONOR IVF AND ICSI: OUTCOMES BY NUMBER OF EMBRYOS TRANSFERRED

	Number of embryos transferred				
	1	**2**	**3**	**≥4**	**Total**
Transfers (*n*/%)	2285 (13.6)	6922 (41.2)	5950 (35.4)	1646 (9.8)	16,803 (100)
PR/ET (%)	23.0	42.2	39.1	39.9	34.3
Pregnancies lost to FU (%)	36.1	44.2	29.9	30.6	37.0
Deliveries (*n*)	297	1215	1367	358	3237
DR/ET (%)	13.0	17.6	23.0	21.7	19.3
Singleton (%)	99.7	77.5	68.2	57.3	73.4
Twin (%)	0.3	22.2	31.2	36.0	25.5
Triplet (%)	0.0	0.3	1.0	8.3	1.2

DR = delivery rate; ET = embryo transfer; FU = follow-up; PR = pregnancy rate.

data. It is worth noting, however, that for the first time centres in 13 countries decided to voluntarily report the results of their work to a centralized system located at the University of Cape Town, South Africa. The number of countries and centres participating is encouraging, and we believe that registry participation will substantially increase in the future. At the same time, progress will require time and is unlikely to be linear.

Participating centres conducted a total of 25,770 initiated cycles. True ART utilization could not be established, with the exception of a few single-centre countries in which it was exceptionally low. Reported ART utilization, reflecting only access to care provided by participating centres, was 55 cycles/million population. While a reliable and representative measure of ART utilization in Africa thus remains to be established, this should not detract from the fact that best available evidence points towards very low utilization. Unsurprisingly, many access barriers to ART in Africa exist, especially financial barriers secondary to weak health systems, numerous competing health priorities, absence of third-party funding schemes, a vast preponderance of private over public ART centres, and low buying power of households (*Botha et al., 2018*). Other barriers include lack of local training and capacity building, with most skills acquired outside the African region; geographical barriers, with no ART services available in many countries and essentially none outside major cities; low levels of reproductive health literacy compromising the ability to access care or evaluate its implications; insufficient cultural and societal acceptance; and religious barriers (*Botha et al., 2018; Gerrits and Shaw, 2010; Inhorn and Patrizio, 2015*). Overcoming these barriers will require various partnerships and strategies. While these are beyond the scope of this discussion, they are likely to benefit from data of the status quo and the monitoring of change.

The vast majority of ART procedures comprised fresh non-donor cycles with ICSI being the method of fertilization in 89.2% of cycles. The high use of ICSI

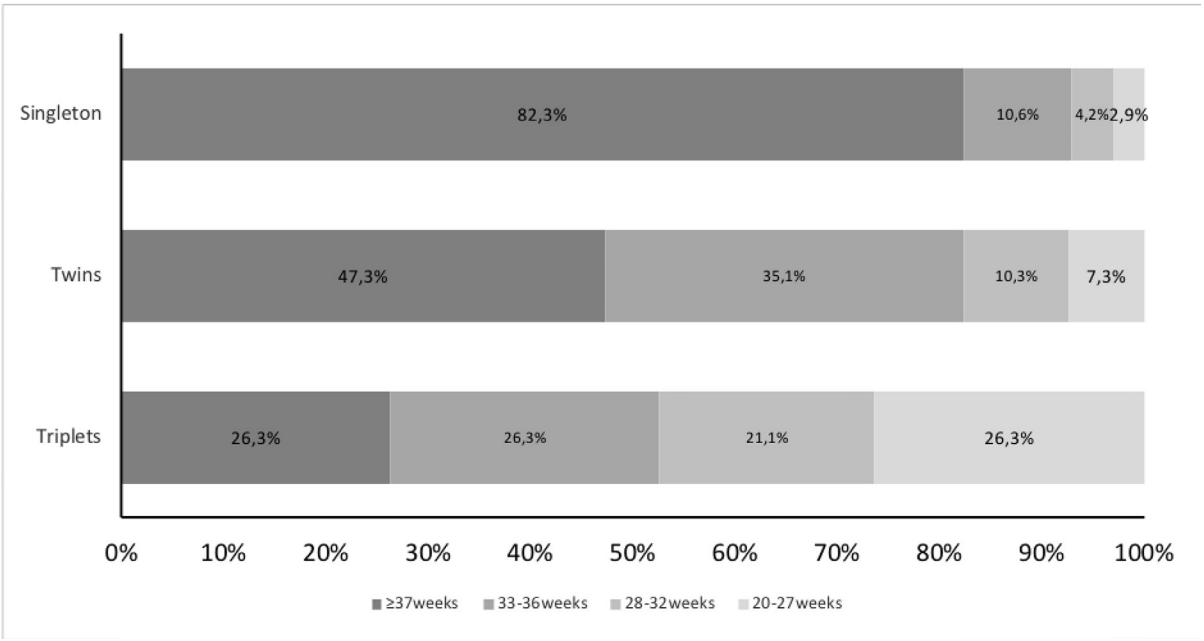

FIGURE 2 Gestational age by type of delivery.

contrasts with mounting evidence that in the absence of male factor infertility, ICSI confers no benefit and indeed has been shown to reduce live birth rates while increasing cost (*Grimstad et al., 2016; Schwarze et al., 2017*). Reasons for Africa's high ICSI rate are speculative but may include preferential access to ART in case of male infertility (related to patriarchal norms and the possibility of polygamy in the case of female infertility), as well as fear expressed by biologists and clinicians of fertilization failure in couples who may, because of limited resources, have a single chance to get pregnant.

Only 7% of all embryo transfers involved oocyte donation. This is likely to reflect the influence of religion, in addition to which beliefs of heritage and kinship may also limit treatment acceptability (*Botha et al., 2018*).

The pregnancy rates per aspiration following fresh non-donor IVF and ICSI (28.0% and 35.8%) suggest good overall effectiveness with expected differences between women in different age groups. Effectiveness must be interpreted in conjunction with the number of embryos transferred and the observation that 57.3% of aspirations were conducted in women ≤34 years. We cannot explain this preponderance of young women, except to postulate that in many African countries the mean age of marriage is relatively early and that a strong need for children may result in early recourse to ART by those able to access care. In addition, older infertile women might be divorced or abandoned, or living with male polygamy. Alternatively, there may be other, unknown mechanisms for patient selection in Africa favouring younger couples. Evidently, excessive use of oocyte donation does not account for our finding given the small proportion of these cycles.

Delivery rates following non-donor IVF and ICSI were unrealistically low (11.7% and 23.9%, respectively), which is most probably attributable to the poor follow-up of pregnant women rather than to poor pregnancy outcomes. The scant data on deliveries and births requires attention as true effectiveness and safety of ART in Africa cannot be established or claimed until such data are available. Follow-up of pregnancies may arguably be more difficult in African countries because of geographic mobility of patients within and between countries, unreliable communication infrastructures, and perhaps secretiveness relating to ART. On the other hand, lacking commitment or capacity from ART centres to follow up patients must also contribute. It is a goal of ANARA to find methods and encourage centres to improve these outcome data.

The number of non-donor FET (n = 3560) was small, resulting in a fresh embryo transfer rate of over 80%. This is unfortunately in accordance with the transfer of multiple embryos as well as lack of facilities for embryo freezing in some ART centres. It will be interesting to monitor whether or how soon Africa will follow the global trend of transferring fewer embryos, increased embryo freezing, and equivocal or even superior results after FET when compared with fresh TF (*Dyer et al., 2016; Shi et al., 2018*).

The mean number of embryos transferred was 2.41 in fresh non-donor cycles, 2.61 in non-donor FET cycles and 2.51 in fresh oocyte donation cycles. These figures are very high and account for the high rate of multiples. Among these, twins had approximately half the chance of singletons to be born at term, and triplets half the chance of twins. These findings are concerning for several reasons, including the fact that the under-5 mortality among all twins in sub-Saharan Africa remains high (200–400/1000 live births in different settings) and is declining at a lower rate compared with that of singletons (*Monden and Smits, 2017*). The benefit of elective single-embryo (eSET) transfer has been established in high-resource countries and represents safest ART practice. It is hence a goal to which ART centres in Africa must aspire. The difficulty of implementing eSET, however, in settings where patients are required to pay out-of-pocket and can often undergo only a single ART cycle has been documented and the associated disadvantages and inequities have been recognized (*Adamson, 2009; Chambers et al., 2014*).

Our data are representative of the participating centres and countries and cannot be extrapolated to all ART centres in Africa. Bias may exist if participating centres represented a larger and more established cohort when compared with non-participants. Indeed, the willingness and ability to share data is in itself a marker of quality. Increasing participation and building capacity for data collection is a primary focus of ANARA and is being pursued through multiple avenues including local and regional conference presentations, data workshops and a biannual newsletter. Further limitations relate to the heterogeneous method of data collection, the heterogeneous quality of the data and the many data gaps, especially but not only pertaining to deliveries and births. Our findings are derived from retrospective summary data which are less robust when compared with more contemporary, cycle-based data collection. This prevented us from reporting cumulative live birth rates per aspiration or woman, which are optimal measures of ART effectiveness. Even an established registry like the European IVF Consortium has not yet been able to overcome the significant logistical challenges of capturing this indicator (*Calhaz-Jorge et al., 2017*). The results presented lag 5 years behind current ART practice. Some time lag is, however, unavoidable due to the need to await pregnancy outcomes and the cleaning and aggregation of data across a large region. No attempt was made to verify the data unless there were mathematical errors. Although data verification would be desirable, greater priority was given to establishing trust, willingness and confidence of participating centres in data reporting and sharing. It is anticipated that some of the above limitations will be reduced once centres have adopted the ANARA or similar appropriate, cycle-based software allowing for more rapid, more robust (cycle-specific) and more reliable (software-inherent data validation) data collection.

The strength of our paper lies in the novelty of findings and their broad scope, drawing data from 13 countries and 40 centres. The authors have experience in national, regional and global ART data collection and insight into infertility and ART in Africa. Lastly, despite limitations pertaining to representativeness, our ANARA data reflect real-life data and are hence more generalizable than those from stricter research settings; they are also more applicable to Africa than extrapolating non-African data to Africa. While the heterogeneity among different population groups and ART settings must also be considered, it is not the purpose of this registry to compare findings between such groups or settings.

This first multinational African Registry generated by ANARA contributes to greater visibility of ART in Africa with many attendant benefits. These include an overall benchmark for Africa; an evidence base for clinical and laboratory practice; a source of information for patients and the public; a focus on data gaps and recognition of the need to narrow or close these; and data to support the mandate of fertility organizations and governmental health departments, which should include the development of practice guidelines or regulations to maximize access and safety of ART. It is anticipated that more ART centres and countries will join ANARA and that this growing synergy between centres, countries and published data will impact positively on the burden of infertility in Africa.

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List of participating centres:
PolyClinique Saint Michel (Benin); Clinique Medicalé Odysée (Cameroon); Alexandria Integrated Fertility Centre, Al Hussin IVF, GANNA Fertility Centre, Institution Ibnsina IVF Centre, The Egyptian IVF Centre (Egypt); Lister Hospital Fertility Centre, Ruma Fertility and Specialist Hospital (Ghana); Clinique Procréa (Ivory Coast); Clinique Kabala (Mali); Anfa Fertility Centre (Morocco); Harley Street Clinic (Mauritius); DIFF Hospital, George's Memorial Medical Centre, Gynescope Specialist Hospital, Hope Valley Fertility Clinic, Medical ART Centre, Nisa Premier Hospital, Nordica Fertility Hospital, Roding Medical Centre, The Bridge Clinic (Nigeria); Laboratoire BIO24 (Senegal); Aevitas Fertility Clinic, Care Clinic, Durban Fertility Clinic, Fembryo Fertility Clinic, Genesis Reproductive Centre, Medfem Fertility Clinic, Natal Fertility Clinic, Pretoria Fertility Centre, Reproductive and Endocrine Unit: Steve Biko Academic Hospital, Reproductive Medicine Unit: Groote Schuur Hospital, Sandton Fertility Centre, Tygerberg Hospital Fertility Clinic, Vitalab Fertility Unit, Wijnland Fertility (South Africa); Clinique Biasa (Togo); Aziza Othmana ART Centre; Centre Médical Ibn Zohr (Tunisia).

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.rbmo.2018.11.001.

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