The status of assisted reproductive technology in the public health sector in Africa – a multi-country survey

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DECLARATION

I, RUMBIDZAI MAJANGARA KARAGA, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Abstract

Introduction: It was presumed that most Assisted Reproductive Technology (ART) centres in Africa existed in the private sector. Over 80% of the South African population accessed medical care at public rather than private institutions; hence availability of a health service in both private and public institutions would ensure equitable access to care.

Objectives: To determine the availability and utilisation of ART services in the public sector in African countries; and the facilitators and barriers towards service provision.

Methods: A mixed methods internet-based cross sectional survey was conducted in Africa in 2 phases. Countries providing ART in Africa were identified from the African Network and Registry of ART (ANARA) database and International Federation of Fertility Societies (IFFS) surveillance report 2019. For phase 1, purposeful sampling of key informants (leaders of fertility societies; contributors to ANARA and IFFS report) was done. Phase 1 participants identified and referred participants for Phase 2, ie- a fertility expert (clinician/ embryologist/ nurse) currently providing ART or previously involved in the establishment or running of a public ART centre. Data were collected via a mostly structured questionnaire (phase one); and semi-structured questionnaire followed by an interview via zoom or WhatsApp calling (phase 2). Data were analysed descriptively based on the principles of grounded theory for qualitative research.

Results:
Phase 1: participants from 17/27 (63.0%) countries known to provide ART responded. Data for South Africa were obtained from the South African Registry of ART (2019).

Public sector ART was available in 10/18 participating countries (55.6%) and 10/16 (62.5%) countries that provided ART. Few of the reported African ART centres were public 24/185 (13.0%). Utilisation of ART was low, <500 ART cycles per annum, in 13/15 public centres where utilisation was reported.

Phase 2: Questionnaires were returned from 6/10 (60%) countries with public ART services and 13/24 (54.2%) identified public ART centres. 8 interviews were done; Nigeria (4), SA (2), Tunisia (1), and Benin (1). Centres mostly agreed there had been local research showing a high burden of infertility requiring ART and the need to help couples that could only access health care in public centres. Patient eligibility criteria for access to ART were utilised variably by 10/13 public centres. The government/ university hospital heavily subsidised ART. Out of pocket co-payments were unavoidable in all centres. The number of ART cycles per annum appeared inversely correlated to the co-payment. The top 3 barriers to ART in the public sector were lack of policy/ legislation; high costs; and bureaucracy. The top 3 measures to promote access to public ART were government buy in, minimising costs and minimising bureaucracy.

Conclusion: Public ART services were available in Africa, but restricted and riddled by many challenges. Funding was the biggest challenge. Adopting measures that reduced co-payments was associated with higher utilisation of services.

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List of Tables

Abbreviations

ANARA- African Network and Registry for Assisted Reproductive Technology

ART- assisted reproductive technology

COVID 19- corona virus disease 2019

dET- double embryo transfer

FD- fertility doctor

FET- frozen embryo transfer

Groote Schuur Hospital- GSH

HAC- Head of ART Centre

HIV/AIDS- Human immunodeficiency virus disease/ Acquired immunodeficiency disease syndrome

HREC REF- Human Research Ethics Committee Reference

ICMART- International Committee for Monitoring Assisted Reproductive Technologies

ICSI- intracytoplasmic sperm injection

IFFS- International Federation of Fertility Societies

IUI- intrauterine insemination

IVF- in vitro fertilisation

LFS- Leader of Fertility Society

MDG- Millennium Development Goals

n- number of participants

NGO- non-governmental organisation

O&G- Obstetrician and Gynaecologist

PH: Public Hospital

PUH: Public University Hospital

PPP- public private partnership

SARA- South African Register of Assisted Reproductive Technologies

SDG- Sustainable Development Goals

sET- elective single embryo transfer

USD- United States Dollars

USOPU- ultrasound guided oocyte retrieval

WHO- World Health Organisation

Chapter 1

1.0 Introduction

Infertility is defined as a disease of the reproductive system characterised by the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse or due to an impairment of a person's capacity to reproduce either as an individual or with his/ her partner (1). It has been classified as a disability by the World Health Organisation (WHO). In a systematic analysis, Mascarenhas and colleagues, using demographic and reproductive health survey data, found that 1.9% and 10.5% of women aged 20–44 y who were exposed to the risk of pregnancy had primary and secondary infertility respectively. The prevalence of infertility was highest in South Asia, Sub-Saharan Africa, North Africa/Middle East, and Central/Eastern Europe and Central Asia (2).

The main causes of infertility are ovulatory disorders, tubal factors and abnormal semen. Some causes of infertility may be treated through lifestyle modification, medications to improve ovulation or semen parameters, surgery and artificial insemination. People with severe tubal factor and male factor infertility, or those who fail to conceive with other interventions, require assisted reproductive technology (ART). ART encompasses all interventions that involve the in vitro handling of both human oocytes and sperm or of embryos for the purpose of reproduction. ART does not include assisted insemination using sperm from either a woman's partner or a sperm donor (1).

According to the International Committee for Monitoring Assisted Reproductive Technologies (ICMART) world report, Africa reports the least number of ART cycles per million population per annum (3). The availability of a health care service in both the public

and private sectors improves equitable access to care (4). Analysis of the distribution of ART centres between the public and private health sector will provide further insight into the availability and financial accessibility of ART; and through this insight into some of the reasons for the low utilization of ART in Africa.

This study aims to document the current status of ART activity in the public health sector in Africa. Assessing facilitators and barriers is a secondary objective.

1.1 Rationale

The ability to produce offspring is a human right (5). The failure to reproduce becomes a distressing condition for the infertile person or couple with long term adverse effects on psychological, physical and sexual well-being. As already stated, infertility has been recognised both as a disease and as a disability.

Infertility is universally associated with a reduced quality of life regardless of race, culture and religion. However, the psychosocial consequences are likely to be more common and more severe in developing countries where children are highly valued and where infertility is often a stigmatising condition (6,7). Infections account for 85% of infertility cases in sub-Saharan Africa, as compared to 33% worldwide (8). This results in a high preponderance of tubal factor infertility whose most effective treatment is assisted reproduction.

In 2010, over 80% of the South African population accessed medical care at public rather than private institutions due to lack of health insurance (9). A similar or even greater use of the public sector for health care may be expected in the other countries in Africa. In the

absence of quality and comprehensive public sector infertility services, these people would struggle to access ART treatment. Furthermore medical insurance in most countries does not cover assisted reproduction or only covers other procedures required before the use of ART. A survey by the International Federation of Fertility Societies, IFFS Surveillance 2019, showed that health insurance offered partial or complete coverage for infertility treatments in only 47% of all countries that responded globally (10). Nine out of eighteen (50%) African countries indicated partial coverage for diagnostic procedures by mainly private insurance. Only 3 of 18 (17%) African countries reported coverage for in vitro fertilisation (IVF) (10).

The distribution of ART in the private and public health sector in Africa is currently poorly documented. This study aims to bridge this information gap.

Chapter 2

Literature Review

What is already known?

ART gives couples affected by severe tubal factor and male factor infertility as well as those not responding to other treatments an opportunity for reproduction (11).

According to the European Society for Human Reproduction and Embryology position statement, universal access to infertility care is a key feature of good clinical care (11). This is in contrast to the low availability of ART in Africa which has some of the highest burden of infertility worldwide (8). Known hindrances to access to ART are lack of knowledge about the existence of ART; ethical, cultural and religious misgivings about ART; and the high cost of ART (12). Power outages, lack of skilled personnel, lack of equipment or service plans for available equipment and unpredictable drug supply chains from overseas countries are other obstacles to ART service provision in Africa (13)

For most medical conditions of public health significance, robust health service delivery is usually based on a functional public and academic backbone. In addition to service provision, the public and academic sectors have a critical role in the advancement of research, training of health care professionals, and ogether with health authorities the provision of stewardship and regulation (14, 15). Private sector participation typically compliments the public sector and improves equitable access. As an example of successful public-private partnerships, Yoong and colleagues used data from Demographic and Health Surveys from 34 sub-Saharan countries to show that participation of the private sector in

maternity care and treatment of childhood respiratory infections was associated with better access and equity of care (4). The private sector has played a sterling role with regards to innovative technology, skills and efficiency necessary for the development and delivery of service in the field of sexual and reproductive health including assisted reproduction (15). However, the lack of public and academic centres in a country disrupts the delicate balance that ensures equitable access to health services, progressive research and training to the less privileged (16). Public- private partnerships can foster an environment conducive for the delivery of high quality health infrastructure and services (15).

Public health priorities in developing countries were mainly centred around the Millennium Development Goals (MDGs) and are now guided by the 2030 Agenda for Sustainable Development goals (SDGs) (17,18). The reproductive health priorities of the MDGs and SDGs are to improve maternal and child health and reduce mortality; to improve family planning through contraceptive and condom use; and HIV/AIDS prevention and treatment (17, 19). This often leads governments and other policy makers to disregard the impact of infertility which is not seen as a disease contributing to mortality. The Guttmacher–Lancet Commission report states that a country ensures the right to sexual and reproductive health when members of its population are allowed to exercise responsible autonomy and have unrestricted access to sexual and reproductive health-related facilities, services, goods and information (20). The absence of public funding violates this right because ART services become only accessible to the few privileged individuals who can afford to bear the cost of treatment on their own. Health financing for universal coverage includes a system where both public health insurance and private health insurance are active. Public health insurance

is a program run by state, federal, or local governments where the government covers some or all of the people's healthcare costs. Private health insurance refers to any health insurance coverage that is offered by a private entity instead of a state or federal government (21).

Some African countries have managed to offer ART services in both the private and public sectors; many have managed to do so only in the private sector, while some have no ART services at all. In countries where ART exists, the vast majority of centres are presumed to exist in the private sector although exact numbers are unknown. Some information can be derived from the IFFS surveillance report but not all countries participate in the report, in addition to which the landscape of ART in Africa is rapidly evolving (10). The African Network and Registry for Assisted Reproductive Technology (ANARA) published their first data from 40 centres in 13 countries in Africa from 2013 showing favourable pregnancy rates per aspiration for 25,770 initiated fresh non-donor IVF and intracytoplasmic injection (ICSI) cycles of 28.0% and 35.8% respectively. Information regarding deliveries was available for 56.1% of pregnancies, while the remainder were lost to follow up. Data was incomplete and there were significant inter-country variations such that regional ART utilisation could not be established for the period under study (22). This is a laudable step towards accounting for the provision of ART services in Africa. In order to improve availability of ART it needs to expand into the public and public-academic sector; predominantly to reduce the cost burden for patients but also in order to strengthen training and research.

What does this study add?

This study aims to assess the current distribution of ART services among the two biomedical health sectors and improve our understanding of the factors that support the existence of ART in public health institutions.

Chapter 3

3.0 Research Question: What is the current availability of ART services in the public sector in African countries and what are the facilitators and barriers towards their provision?

3.1 Study aim and objectives

Aim: To document the current status of ART services in the public sector in African countries and to get preliminary insight into facilitators and barriers towards their provision.

3.1.1 Primary objectives: (Phase 1)

i. To establish the total number of ART centres in a country
ii. To establish the number of these in the public sector
iii. To determine the type of the public centre ie whether public, public-academic, mission hospital, or other
iv. To determine the year in which the public centre was established
v. To determine the number or estimated number of ART cycles conducted per annum in each public centre

3.1.2 Secondary objectives: (Phase 2)

Pertaining to each public centre, to briefly explore

i. what led to its establishment
ii. patient eligibility criteria

iii. how ART is funded

iv. what supports/facilitates ART service delivery

v. challenges to ART service delivery

3.2 Methods:

3.2.1 Study design:

The study was a mixed methods cross sectional study to obtain descriptive quantitative (Phase 1) and qualitative data (Phase 2).

3.2.2 Study setting: African continent

3.2.3: Study population/ Inclusion criteria:

Key informants representing African ART centres or leaders of reproductive networks of ART in Africa

3.2.4: Inclusion criteria:

Phase 1: Informants from the following 4 groups willing to participate and able to communicate in English or French

1. Informants representing ART centres belonging to ANARA
2. Leaders of reproductive networks in Africa (ie- fertility societies) that do not belong to Group 1
3. IFFS survey contributors that do not also belong to Group 1 or 2

4. A service provider who is knowledgeable about ART service provision in their country and who is recommended by a participant in group 1-3, but does not belong to group 1-3

Phase 2: Informants from the following groups willing to participate and able to communicate in English or French

1. A fertility expert (described as a clinician or embryologist or nurse) providing ART services in a public centre in Africa or previously involved in the establishment or running of a public ART centre
2. An individual who is knowledgeable about a public ART centre(s) in their country.

3.2.5 Exclusion criteria: There were no exclusion criteria.

3.2.6: Sampling Plan:

Purposeful sampling was done to identify key informants. The ANARA database and IFFS surveillance 2019 were searched to identify countries providing ART services in Africa. Representatives belonging to the groups outlined under point 3.2.4 were invited to participate in Phase 1 of the survey. When more than one respondent from one centre responded, the provided information was collated and, in case of inconsistency clarity was sought from the informants. These informants were requested to identify other suitable experts on public ART centres in their country for participation in phase 2 of the survey. For

phase 2, efforts were made to identify two to three key informants per public centre for the sake of greater depth of the qualitative data.

3.2.7 Sample size determination:

Based on data from the African Network and Registry for Assisted Reproductive Technology (ANARA) and the International Federation of Fertility Societies Surveillance 2019 (IFFS 2019), 28 countries were known to offer ART services in Africa. Efforts were made to reach out to all countries known to offer ART.

3.2.8 Data collection

Tools:

Phase 1:

a) questionnaire mostly structured to obtain quantitative data plus limited semi-structured questions

Phase 2:

a) semi-structured questionnaire
b) Semi-structured in-person in-depth interview via zoom or WhatsApp call

Phase 1 of the study began on 18 February 2020 when the first set of eleven informants was sent an email invitation containing a unique web-link to the questionnaire on Survey Monkey and the ethics committee approval document. The remaining informants were invited a week later to make a total of 47 invited informants. An automatic email reminder

was set up to be sent after seven days via Survey Monkey for all informants. A second (and last) reminder was sent after another seven days to the first eleven informants via Gmail of the investigator in case the survey monkey configuration of the email affected response rate. When this did not change the response pattern, the second reminder was sent via survey monkey for the remainder of the informants.

The email invitations and questionnaire for participants from French speaking countries (Burkina Faso and Ivory Coast) were translated to French using google translate. A French speaking colleague (Congolese National) was asked to proof read the translation.

Phase 2 of the survey began on 11 february 2021. Informants who participated in phase 1 were sent an email requesting them to identify, refer, and provide us with the contact details of 2 to 3 key informants from each public centre in their country.

An email invitation to participate in Phase 2 of the study was sent to the identified public centre informants. The questionnaire and ethics committee approval document were attached to the email.

A time period of 1 week was given to allow public centre informants to formulate their answers and return the questionnaire. If there was no response, two reminders at least one week apart were emailed to the participants. All participants that returned the questionnaire were invited to an interview via zoom or WhatsApp calling to explain their opinions.

The voice calls were recorded and the interviewer took field notes concurrently.

When public centre informants in a country could not be reached, informants identified from the ANARA network were relied on to give as much information as they could about the public centres for phase 2 in their countries.

Failure of communication was defined as failure to get a response after three attempts at communication on three different days, at least one week apart.

3.2.9 Data analysis

Quantitative data were captured and entered into tables on Microsoft excel spread sheet. Consistency and logic checks were done. Quantitative data were analysed predominantly descriptively. Categorical variables were expressed as percentages and frequencies. Descriptive statistics were expressed as ranges for quantitative variables that were normally distributed or skewed respectively.

Qualitative data were transcribed, coded into common themes and analysed descriptively based on the principles of grounded theory. Grounded Theory is a qualitative research method in which the theory is derived from the data obtained during research. The analysis of data is not influenced by pre-existing constructs. If any existing theoretical constructs are employed, they must be justified in the data (23).

For the purposes of verbal counting in this study; “many or majority or commonly “referred to >50% of respondents; “some or several” referred to 33% to 50% of respondents while “few” referred to <33% of respondents.

3.2.8 Ethical Considerations

Ethical approval (HREC REF 235/2019) was obtained from the Human Research Ethics Committee, Faculty of Health Sciences of the University of Cape Town. The purpose of the

study was explained to all potential informants. Informants were advised that the return of the questionnaire was taken as indication of their consent to participate. Informants were informed that they were free not to participate and that they were free not to answer any questions on the questionnaire. Contact information of the informants such as email address and WhatsApp contacts were accessed only by the investigators and no further communication was done beyond the objectives of the study. Only non-identifying demographic data of informants was requested for in the questionnaire. Informants had the right to insist that their personal information not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, know about their involvement in this research. Permission to record the interviews in phase 2 was sought at the beginning of the interview from all informants who agreed to participate. Only overall descriptive information regarding ART services was collected. Information obtained was stored in a password locked computer. There was no financial or other compensation for participating in the study.

Chapter 4: Results Phase 1

Potential informants for phase 1 were identified from 25 countries known to offer ART and 2 countries not known to offer ART (Angola and Malawi) to make a total of 27 countries. Respondents from Angola and Malawi met inclusion criteria as per section 3.2.4 group 4. The number of informants invited per country depended on the number of known contacts within the ANARA data base and those recommended as being knowledgeable about their respective countries by other key informants. Of countries known to offer ART, we did not find credible contacts for Madagascar and Tanzania from the ANARA database, other informants as per section 3.2.4 nor form an internet search at the time. These two countries were documented to offer ART in the IFFS 2019, but were not members of ANARA. South Africa was part of the 28 countries that offered ART, but was excluded from the Phase 1 survey because the 4 public ART centres were already known by the investigators through the South African Register of Assisted Reproductive Technologies (SARA) and would be readily approached for Phase 2 of the survey.

Responses were obtained from representatives of 17 out of 27 countries, a 63.0% country response rate. Nineteen of forty-seven individuals that were invited to participate responded, a 40.4% per individual response rate.

Demographics of Respondents

Tables 1 and 2 outline the invited participants and the demographics of respondents stratified by country.

Table 1: Demographics of respondents Phase 1

Country	Participants invited (n)	Participants responded (n)	Position	Place of work	Respondent's Age (years)	Number of years worked in ART
Algeria	1	1	FD LFS HAC Head of fertility diploma under aegis of higher education	Private, supports publicly funded military & police insurance	55	16-20
Angola	1	1	General O&G	Semi-private general hospital with maternity	41	<5
Benin	1	1	Embryologist/ biologist	Public Art Centre	36	<5
Cameroon	1	1	FD HAC Head of private centre ART data	Private	65	>20
Democratic Republic of Congo	1	1	General O&G currently training in ART	Public & private but not ART centers	40	<5
Ethiopia	1	1	HAC	Private	52	16-20
Ghana	3	1 1	FD Embryologist, HAC	Private Private	45 53	5-10 >20
Kenya	4	1	FD LFS HAC	Private	65	11-15
Libya	2	1	Embryologist/ biologist	Private	31	11-15
Malawi	1	1	O&G head of team looking after infertile patients	Public with limited ART capacity but able to support a good number of couples	35	<5
Morocco	4	1	FD HAC LFS	Private	51	16-20
Namibia	2	1 1	FD FD	Private Private	51 62	>20 5-10
Nigeria	3	1	FD HAC	Private	51	5-10
Sudan	3	1	FD	Private that supports patients on public funding	41	5-10
Tunisia	3	1	FD	Private	40	11-15
Zambia	1	1	O&G with 3 months ART training	Public general hospital	41	<5
Zimbabwe	2	1	FD with 3 months ART training	Public-University hospital	47	<5

FD- fertility doctor LFS- Leader of Fertility Society HAC- Head of ART Centre
O&G- Obstetrician and Gynaecologist n- number of participants

Table 2: Participants from countries known to offer ART according to IFFS Surveillance 2019 who did not respond

Country	**n invited**
Botswana	1
Burkina Faso	1
Egypt	3
Ivory Coast	1
Mali	1
Mauritius	1
Rwanda	1
Senegal	1
Togo	1
Uganda	2
Total	13

No participants responded in French

Availability of ART in Africa

Table 3: Number and type of ART centres by Country Phase 1

Country	**Number of centres reported to exist (n)**	**Type of ART centres**					**PPP**
		Private clinic/hospital (n)	**Public hospital (n)**	**Public-university hospital (n)**	**Mission/faith based (n)**	**NGO clinic/ hospital (n)**	
Algeria	20	19	0	1	0	0	Yes[a]
Benin	2	1	0	1	0	0	No
Angola	0	0	0	0	0	0	No
Cameroon	4	3	1	0	0	0	No
DRC	1	1	0	0	0	0	No
Ethiopia	2	1	0	1	0	0	No
Ghana	15	15	0	0	0	0	No
Kenya	9	9	0	0	0	0	No
Libya	16	12	4	0	0	0	No
Malawi	0	0	0	0	0	0	No
Morocco	16	14	0	2	0	0	No
Namibia	2	2	0	0	0	0	No
Nigeria	53	46	0	7	0	0	No
South Africa	22	18	0	4	0	0	No
Sudan	10	9	1	0	0	0	No[b]
Tunisia	10	8	0	2	0	0	Yes[c]
Zambia	1	1	0	0	0	0	No
Zimbabwe	2	2	0	0	0	0	No
Total	185	161	6	18	0	0	-

For the purpose of presenting these results and completeness of data, South Africa is included in this table. Data was obtained from the South African Register of Assisted Reproductive Techniques 2019 (Unpublished)

PPP- Public Private Partnerships where public funds fully or partially fund access to ART in the private sector

NGO- Non Governmental Organisation

[a] military and police insurances

[b] discrepant answers as respondent's place of work is a private centre that supports patients on public funding

[c] National insurance covers medications for both public and private

A total of 185 ART centres were reported to exist in 16 of 18 countries (including South Africa). Twenty-four of 185 (13%) were public centres, see Table 3. ART services were available in the public sector in 10/18 (55.6%) participating countries and 10/16 (62.5%) of countries providing ART. Table 4 lists the available public ART centres and their characteristics.

Table 4: Public ART centres Phase 1

Country	Name of public ART centre	Type of public ART centre	Year of establishment	Number of ART cycles per annum
Algeria	Nefissa Hammound Hospital ex Parnet Algiers	PUH	2012	201-500
Benin	Laboratoire d'Histologie, Biologie de la Reproduction, Cytogenetique et Génétique médicale	PUH	2015	-
Cameroon	CRACERH Hospital Yaoundé	PH	2017	<100
Ethiopia	St Paul's Centre for Fertility and Reproductive Medicine	PUH	2019	<100
Libya	Misurata Fertility Centre	PH	2012	501-1000
	Tripoli Fertility Centre	PH	2013	201-500
	Al-Bayda Fertility Centre	PH	2013	201-500
	Bangaze Fertility Centre	PH	2016	101-200
Morocco	ART Centre Les Orangers Rabat	PUH	Unknown	200
	University IVF Centre Marrakech	PUH	Unknown	100
South Africa	University of Pretoria Reproductive Endocrine Clinic	PUH	-	201-500
	Tygerberg Fertility Clinic	PUH	-	201-500
	Groote Schuur Hospital Reproductive Medicine Unit	PUH	-	201-500
	Universitas Academic Hospital Fertility Clinic	PUH	-	-
Sudan	Saad, Abu Elella Fertility Centre	PH	2012	200
Tunisia	Aziza Othmana ART Centre Tunis	PUH	1999	501-1000
	Farhat Hached ART Centre Sousse	PUH	2002	201-500

PH: Public Hospital PUH: Public University Hospital

- Information not available

For the purpose of presenting these results and completeness of data, South Africa is included in this table. Data was obtained from the South African Register of Assisted Reproductive Techniques 2019 (Unpublished)

Seven of 53 ART centers in Nigeria were public-university based ART centers. However no information was given regarding the name, year of establishment and number of ART cycles performed per annum for each centre.

CRACERH Hospital Yaoundé, Cameroon was sponsored by the First Lady of Cameroon. The type and degree of sponsorship was not mentioned. Of note was that there were no institutions run by mission/ faith-based organisations or other non-governmental organisations in the countries that were represented.

Three countries Algeria, Sudan and Tunisia had public-private partnerships where public health insurance covered access to ART in private centres. In Tunisia, the National Insurance covered medications for treatment in both public and private institutions. Cover was specifically for selected public officials in Algeria viz, police and military members. The extent of cover was not stated nor why only uniformed forces had been chosen out of the entire public workforce. For Sudan, the extent of support for patients on public insurance was not stated.

Factors that support ART service delivery in the public health sector

The most commonly cited factor that would improve access to ART in the public sector was the availability of funding. Respondents called for the availability of funding from both government and private insurance in the form of partial or comprehensive cover. Government subsidies for low-income patients were suggested. Public centers were encouraged to cooperate with private centers in the form of public-private partnerships. It

was suggested that Pharmaceutical companies could contribute by availing affordable and appropriate drugs for stimulation to patients attending public centers

Government and political approval of, support of, and involvement in setting up ART services was essential according to many respondents. To quote a respondent from Angola, “A couple of gynaecologists did their training in ART abroad, and are ready to work in our country. They designed the procedures and legal documents for the procedures to be done here. About two private centers were built and equipped with material, and Brazilian doctors were available to perform training in Angola. A lot of patients with fertility problems request this service, and the majority travel abroad to get their treatment. Unfortunately, the law is not yet approved by the parliament. The documents are sitting there waiting for approval”.

It was pointed out that more centers should be established within government owned hospitals and that these centers should be distributed equitably and proportionate to the population distribution. ART centers were encouraged to invest in new technologies, and to enhance the training of embryologists and reproductive medicine specialists in the public health setting. It was suggested to encourage and support registrars/ residents to dedicate more time towards ART courses during their training.

A few respondents emphasized the need for an independent budget and management team for the IVF unit within the public hospital as well as staff members permanently assigned to the ART unit.

Population education to increase their awareness of the availability of and indications for ART was advocated. Good success rates of the different ART treatments and improved results of ART in public centres were proposed as essential to the provision of publicly funded ART. It was mentioned that ART procedures may be “heavy” on patients; hence adoption of patient friendly procedures may improve the uptake of ART. One respondent suggested establishment of a national association of couples with infertility to encourage public opening of the debate on infertility.

Challenges to ART service delivery in the public sector

Bureaucracy was cited by many as a major hindrance to the delivery of ART services. Lack of policy and lack of government legislation derailed efforts to the provision of ART services by interested individuals and bodies as was the case with Angola. “Young infertility policy” was also identified as a significant limitation. Some countries had no clear plan to organise work in this sector, while some systems had complicated pathways for patients to eventually access ART.

Many respondents lamented the lack of acknowledgement of infertility as a public health problem by policy makers. They acknowledged that there were other illnesses with more obvious manifestations; hence infertility was not a government priority. They revealed that communities were not well sensitised regarding infertility and its treatment options including ART and that there was limited promotional advertising for ART centres. A few respondents mentioned that there was stigma towards ART services and “lack of goodwill”.

Financial constraints were alluded to by almost all respondents who bemoaned several constraints documented henceforth. Countries with low gross domestic product and social security had limited capacity to provide ART services in the public sector. This was manifested as inability to set up ART units; lack of laboratory equipment and skilled human resources; and unstable power supply. Generators and other running costs were very expensive. There was limited funding to support treatment and investigations. The cost of ART to the individual patient even in the available public or university hospitals remained high.

ART centres were not equitably distributed. It was mentioned that most ART centres were located in urban areas, leaving rural areas underserved.

Phase 2 Results

Informants from 6 of 10 (60%) countries that had been identified to have ART in the public sector in Phase 1, participated in phase 2. A total of 15 questionnaires were returned from Nigeria (6), Tunisia (2), South Africa (4), Algeria (1), Benin (1) and Cameroon (1). Eight interviews were granted by participants from Nigeria (4), South Africa (2), Tunisia (1), and Benin (1). Invitees from Ethiopia, Libya, Morocco and Sudan did not consent to participate in phase 2.

Demographics of Respondents

Table 5 outlines the demographics of respondents stratified by country.

Table 5: Demographics of respondents Phase 2

Country	**Name of public ART centre**	**Position**	**Respondent's Age (years)**	**Number of years worked in ART**
Algeria	Works in private (Tiziri IVF centre Algiers) but knowledgeable about public centres	HAC FD Leader of national or regional fertility society	56	16-20
Benin	Laboratory of Histology, Reproductive Biology, cytogenetic and Medical Genetic	Embryologist/ biologist	37	<5
Cameroon	Gynaecological Endoscopic Surgery and Human Reproductive Teaching Hospital (CRACERH)	FD HAC	60	16-20
Nigeria	IVF centre, National Hospital Abuja, Nigeria	FD	55y	16-20
	Jos University Teaching Hospital, Jos, Plateau state, Nigeria	FD HAC	57	6-10
	University of Port Harcourt	FD	54	16-20
		HAC FD	67	<5
	University of Ilorin Teaching Hospital IVF centre	HAC FD	46	6-10
	University college of Ibadan	FD HAC	54	<5
South Africa	University of Pretoria Reproductive and Endocrine Clinic	FD HAC	56	11-15
	Tygerberg Fertility Clinic	FD HAC	46	11-15
	Groote Schuur Hospital Reproductive Medicine Unit	FD	47	11-15
		FD	-	>20
	Universitas Academic Hospital fertility clinic	HAC Physician	52	6-10
Tunisia	Unit of Reproductive Medicine Hospital University	HAC LFS clinical embryologist/physician	59	>20
	Reproductive Medicine centre of Aziza Othmana University Hospital Tunis	FD LFS HAC	37	6-10

FD- fertility doctor HAC- Head of ART centre LFS- Leader of Fertility Society

n- number of participants

Table 6 lists the available public ART centres and their characteristics.

Table 6: Utilisation and funding of Public ART centres

Country	**Name of public ART centre**	**Number of ART cycles per annum**	**Average out of pocket payment for one ART cycle[a] (USD)**
Algeria	Nefissa Hammound Hospital ex Parnet Algiers	201-500	Information not available
Benin	Laboratoire d'Histologie, Biologie de la Reproduction, Cytogenetique et Génétique médicale	Still being established	
Cameroon	CHRACERH Hospital Yaoundé	300	1800
Nigeria	IVF centre, National Hospital Abuja, Nigeria	200-350	2000-3500
	Jos University Teaching Hospital, Jos, Plateau state, Nigeria	4	1500
	University of Port Harcourt	60	1800-2400
	Ilorin Teaching Hospital IVF centre	100	3000
	University college of Ibadan	20	2000
South Africa	Groote Schuur Hospital Reproductive Medicine Unit	130	1400
	Tygerburg Fertility Clinic	400	850
	Universitas Academic Hospital Fertility Clinic	0 at time of study. Previously 120	3000-4000[b]
Tunisia	Aziza Othmana ART Centre Tunis	1150	30(IVF), 95(ICSI)
	Farhat Hached Unit of Reproductive Medicine Hospital University Sousse	800	160

[a]ART cycle refers to the process from ovarian stimulation up to embryo transfer and confirmation of pregnancy
[b]The responded did not explain how the fee is apportioned between the public hospital and the private clinic

Public ART centres were subsidised by governments and/or their academic host institution through payment of salaries, infrastructure or procedural costs such as consultations, ultrasound and surgery. In Algeria and Tunisia, health insurance provided full cover for medications for 3cycles and partially covered laboratory costs for IVF/ICSI. In Tunisia, 65% of patients used public insurance, 30% private insurance, while 5% had no insurance.

The number of ART cycles per annum appeared inversely correlated to the average out-of-pocket payment for ART. Information about the cost of ART treatment at University of

Pretoria in South Africa was not given. There was no response from the following public ART centres in Nigeria- University of Benin Teaching Hospital and Lagos University Teaching Hospital (LUTH) Idi-araba Lagos.

How public ART centres were established

This information was obtained from the 8 centers that granted interviews. All respondents mentioned that private ART centres were established first followed by public centers.

The first IVF pregnancy in South Africa was at Tygerburg hospital in 1982 as reported by the respondent for Groote Schuur Hospital (GSH). ART began in 1983 at GSH Reproductive Medicine Unit (South Africa). After research showing a high burden of tubal factor infertility, a young gynaecologist was sponsored by the department to go for training at Monash University, Melbourne, Australia. At the beginning, GSH performed natural cycle IVF until ovarian hyperstimulation was introduced worldwide. ART was sponsored by well-wishers who donated funds to the hospital. The government hospital acquired all the required equipment and remunerated staff. Patients were treated free of charge in the early years. It was not clear when or why IVF without out of pocket payment by the patient was stopped. Challenges at initiation included religious objections eg- by the Catholic Priest who said IVF was “not God’s work”. ART could not be performed on single or same sex couples due to cultural objections. The indigenous population had difficulties with acceptance/ performance of masturbation to produce semen specimens; “after oocyte retrieval for our first patient, the male partner could not give us sperm. He went away and returned with a

lady to help him". Acceptance of ART improved with time as more people achieved pregnancy and live birth.

The history for Universitas Academic Hospital Fertility Clinic (South Africa) was unclear as the pioneering health team was no longer with the hospital. It was reported that ART service commenced in the 1980s with a full complement of trained doctors and embryologists. At its peak, the centre performed up to 120 cycles per annum. At the time of the interview, the centre was performing ovarian stimulation and sending patients to a private ART laboratory for oocyte retrieval, fertilisation, culture and embryo transfer. ART procedures were stopped in 2019 due to the breakdown of the air conditioning system and the ICSI machine; attrition of the human resource when 2 embryologists and an ART doctor left for the private sector for personal, professional and financial reasons as well as additional pressures on resources brought by the COVID 19 pandemic.

Farhat Hachet Hospital (Tunisia) began with simple equipment for simple procedures eg-intrauterine insemination (IUI) then progressed to IVF, and then ICSI and cryopreservation as technology advanced. Initially the centre would send patients to private for the unavailable procedures. Equipment which cost less than USD50 000 (United States Dollars) was purchased by the hospital, while that costing greater than USD50 000 was purchased by the government. The centre sustained because it had technology as good as that found in private hospitals, and the fifth best pregnancy rate in the country. There were 20 ART centres in Tunisia, of which 2 were in the public sector.

Clinicians at National Hospital Abuja (Nigeria) embarked on research that demonstrated a high burden of infertility and managed to convince the government and hospital management to procure equipment such as incubator, laminar flow machines and microscopes. Committed personnel were carefully selected based on their service record and passion for work. Doctors underwent mostly self-sponsored short term training of up to 3 months at foreign institutions eg- Tygerberg Hospital in South Africa and Israel. In the beginning, the centre utilised locum embryologists from private ART centres, then assigned in house laboratory scientists who shadowed the locums and had knowledge and skills imparted to them over time. Some embryologists went for advanced training courses lasting 2-3months outside Nigeria, sponsored by the government or self. Similarly, experienced nurses were recruited from private and these then trained others. Services offered at the centre are ovulation induction with timed intercourse or intrauterine insemination, IVF/ICSI, surgical sperm retrieval and sperm cryopreservation for oncofertility, oocyte and sperm donation. The centre did not have an onsite commercial sperm bank to avoid upsetting other people opposed to sperm donation, however donor sperm could be sourced from other hospitals when needed. For sustainability, ART was on a cash upfront basis in all of Nigeria. No insurance which paid after treatment was accepted to avoid defaulters.

At Jos University (Nigeria), plans to establish ART services began in 2018 as a joint venture between the university and the government hospital. The government built the facility and acquired some equipment. The university facilitated the training of doctors, embryologists and nurses at overseas institutions such as Apollo Fertility and acquired equipment such as

an ICSI machine, laminar flow cabinet, etc. Seven clinicians were trained, but 4 were working in the centre at the time. There were 2 embryologists who took training courses lasting 3-6months. The first IVF stimulation cycle was performed in the year 2020 and the expected date of delivery was in 2021. The centre was offering IVF/ICSI, with plans to offer cryopreservation underway.

The University of Port Harcourt hospital (Nigeria) approached a private company, represented by an embryologist who marketed IVF equipment, to procure equipment that would be paid off over time. The equipment was bought and stayed in storage for nearly 5 years. It took 7 years from initiation of negotiations to commencement of ART activity at the institution in 2018. By 2020, the Hospital had completed paying off the debt. Two doctors and 1 nurse who had trained while working at a Nigerian private facility for 2 years were recruited and they trained others. Two embryologists were sent for training at a Nigerian private facility for 6 months. At the public facility, they continued to work with experienced locum embryologists (from private) during cycles to continue improving their skills. Training was at the expense of the hospital. The hospital offered IVF/ ICSI, cryopreservation, and third party reproduction (Sperm bank and oocyte bank are available). Preimplantation genetic testing was not available.

The medical director at Ilorin Teaching Hospital (Nigeria) was an obstetrician and gynaecologist who understood that a significant proportion of fertility problems could not be resolved with conventional fertility treatment and required ART. In 2011, the Government sponsored a doctor, 2 nurses and an embryologist to go for training lasting 3

months in India at Apollo Hospital and Chennai Fertility Centre. ART service commenced in 2012. Subsequently, doctors undertook several self-sponsored courses to improve their skills.

The Reproductive Biology Laboratory in Benin was started at the University of Abomeyy Calabe in 2015. The biologist was trained in France at Strasboug University. The centre was still in the preliminary stages of developing ART services under the auspices of the university Dean and officials from the Ministry of Health in Benin. At the time of the interview, the centre performed about 6 IUI cycles per annum. The patients were derived from both the private sector (mostly) and the university hospital. The cost of IUI was 150USD.

Patient eligibility criteria

Most centres instituted patient selection criteria for access to ART. A few centres indicated that they did not utilise any specific patient selection criteria, viz Tygerberg Fertility Clinic, South Africa; National Hospital Abuja, Nigeria; and University of Port Harcourt, Nigeria.

The majority of countries (5 of 6), except South Africa, required the female to have a male partner. In South Africa, treatment was available to both heterosexual and homosexual couples and single persons.

The lower age limit was 18 to 21years. The upper age limit for use of autologous oocytes was 42 years in most centers, while a few accommodated well-counselled older women for the purposes of closure. The upper age limit for utilising donor oocytes ranged from 46 years at GSH, South Africa to 60 years at CRARCEH, Cameroon and University of Ilorin Teaching Hospital, Nigeria. Procedures were reportedly performed on well informed older patients who accepted risks associated with ART treatment at their age. Respondents did not clarify whether gamete donors were known or unknown or both. The public centres in Tunisia and Algeria assisted only females aged <42 years. Gamete donation was not permitted by the national law in Tunisia. The male age limit was 56 years at GSH, South Africa. Other centers did not define a male age limit.

The majority of countries did not discriminate patients based on their geographic location. In fact Farhat Hatchet ART Centre, Tunisia also serviced countries within a regional block covered by their convention, viz- Algeria, Libya, Morocco and Mauritania. Social security in one country covered treatment in the other countries at the same cost. Nigerian ART centers also reported assisting foreigners at costs similar to indigent people. In South Africa, prospective parents had to live in the geographic drainage area for the hospital.

Couples were helped to attain a maximum of 2 children in union at GSH, South Africa and 3 children at Ilorin University. Other centres did not mention the number of children as a limiting factor.

Farhat Hatchet ART Centre in Tunisia did not assist those with infectious disease (HIV, hepatitis) due to lack of separate dedicated equipment. They referred to other centres. At Port Harcourt University, HIV infected couples were also treated. Some centres considered the presence of a poorly controlled maternal medical condition as an exclusion criterion. The maternal body mass index was required to be <33 at GSH, South Africa. At Universitas Academic Hospital Fertility Clinic prospective parents had to be mentally stable, and have economic stability as proved by a steady source of income to be able to take care of the baby.

How ART is funded and procedures that were put in place to make ART more affordable

Most respondents mentioned that at public institutions, certain parts of the process were subsidised by the government such as salaries for staff members, physician consults, ultrasound scans, and surgery. The out of pocket component that patient paid was actually a co-payment.

Ensuring a freely standing autonomous IVF centre providing consultation rooms, theatre, IVF laboratory under one roof was reported to be associated with lower costs by many centres.

Other centres introduced payment schedules in which patients could pay part of the fee eg- “technical fee” in Nigeria, then return for the procedure up to several months later when they had acquired money to buy medication. Payment schedules were also available in

Algeria, but the exact form was not revealed. Public private partnerships between the police and military institutions with private ART laboratories increased options for care.

At CRACERH Hospital in Cameron, the amount of time spent in the clinic was not factored in the cost of the service. Prices of medications needed for ovarian stimulation were negotiated with pharmaceutical companies to allow patients to buy at wholesale prices. If no embryos were obtained at the end of the IVF procedure, the patient was reimbursed a third of the normal price. IVF cost 1800USD excluding the cost of drugs. Oocyte and sperm donation were free of charge and anonymous, “while pairing criteria were duly respected”. These pairing criteria were not explained further by the responded.

The Tunisian government heavily subsidised ART procedures at both public centres. Medications were covered by social security or private insurance for 3 cycles. Exclusion criteria for insurance cover at Farhat Hachet ART Centre were women aged > 40years and those who had at least one child. Both IVF and ICSI cost USD 160 which covered cycle monitoring, ultrasound guided oocyte retrieval (USOPU), fertilisation, embryo culture and embryo transfer. The same procedures cost greater than USD 1000 in private facilities.

Many centres in Nigeria adopted the practice of batching patients into treatment groups and offered flexible payment terms. Patients recommended for ART would pay a “technical fee” to show commitment and allow them to be batched. Patients would then go away to raise money for recommended medications and return for the procedure even 6 months

later. The technical fee ranged from USD 700 to 1000 and covered the cost for counselling, monitoring the stimulation cycle, administration, USOPU - which constituted about 70% of the fee in one centre), and embryo transfer. Breaking down the technical fee into several components helped especially when the patient did not manage to complete some procedures, eg embryo transfer which could be refunded. The same fee was charged for IVF and ICSI in most centres in Nigeria. It was cumbersome to charge separate fees for IVF and ICSI because some patients initially slated for IVF who then required ICSI based on semen analysis on the day of USOPU then claimed they did not have additional funds for ICSI.

The staff at IVF Centre National hospital Abuja (Nigeria) would plan and procure media, drugs and other consumables once they had a batch of about 100 patients, accumulated over 2 to 3 months. Consumables would be bought in bulk for immediate use, preventing media and drugs from expiring before use. These patients would start treatment over 3 to 4 weeks, eg- 3 to 4 patients started stimulation medication per day. They did not perform single embryo transfer because most patients would have sold their entire inheritance to do IVF, ie- they had only one chance. Good prognosis patients typically underwent double or triple embryo transfer. The centre did not transfer >4 embryos. Treatment for staff members was subsidised for the purposes of motivating them. Four to five eligible staff members were allowed to join a batch during which they received a 100% waiver of the technical fee during the first ART cycle and 50% waiver for any additional cycles. However, they would pay 100% of the fee for drugs. The centre used “low cost stimulation” which they defined as selecting the cheaper drug at any given time rather than strictly sticking to recombinant gonadotropins only or 1 brand. Egg sharing, a type of oocyte donation in which the recipient paid for the IVF cycle and the donor shared the retrieved oocytes equally with the donor was performed at IVF Centre National Hospital Abuja. However if <6 oocytes were

retrieved, the recipient would not receive any oocytes. The donor would reimburse the fee for stimulation, but not the technical fee to the recipient.

At Ilorin University Hospital (Nigeria), free IVF was performed for 5 indigent patients per year who had been assessed and found unable to afford IVF/ICSI. There was no discrimination based on age or indication or prognosis. The technical fee was discounted by 25% for patients undergoing the second or more cycles of IVF. Frozen embryo transfer (FET) was not performed as a way of avoiding the cost of cryopreservation. The centre was 6 hours away from the capital city therefore the supply chain for liquid nitrogen was not consistent. As a result, 2 to 3 embryos were routinely transferred.

At Universitas Academic Hospital Fertility Clinic (South Africa), IVF became more expensive as patients were now undergoing oocyte retrieval, insemination, embryo culture, embryo transfer and cryopreservation at a private facility (Vitalab) since 2019. To mitigate costs, the initial consultation, investigations and IVF stimulation were performed at the public hospital. Patients were then transferred to private for the ART laboratory procedures. Arrangements were being made for external fertility specialists to come for training workshops and impart skills. Dispensing medications from within the unit cut costs.

Tygerberg Fertility Clinic (South Africa) adopted a mild ovarian stimulation protocol encompassing oral ovulation induction agents and minimal gonadotropin doses. Laboratory procedures were modified. However there was no success in obtaining an interview for clarification of these procedures.

At Groote Schuur Hospital Reproductive Medicine Unit (South Africa), government subsidy catered for most of the reduction in cost.

Factors reported to limit the delivery of ART in the public sector

Many respondents lamented that governments did not prioritise fertility and infertility therapy in their budgets and medical insurance companies did not offer ART benefits.
IVF treatment was expensive. In Algeria, the cost of IVF was five times higher than the minimum wage. Even after maximal subsidy, some patients still could not afford IVF due to poverty. ART drugs were not included on the Essential Drugs list, hence they were only found in private pharmacies at exorbitant prices. Centres faced financial and logistical difficulties and delays during procurement of expensive equipment, consumables and drugs which were all typically manufactured and imported from overseas. This stalled ART procedures in some instances.

Public ART centres were very few making them inaccessible for patients from far geographic locations. Fully trained human resources were scarce. Industrial strikes in some centres disrupted operations. The increased demand on the limited service increased waiting periods.

IVF treatment failures discouraged many patients who would have endured high financial and psychological costs. Lack of a dedicated and consistent management system in the ART unit created administrative bottle necks.
Lack of public awareness of fertility services was associated with reduced utilisation.

Measures suggested to support or promote ART service delivery in the public health sector

Respondents urged Governments to regard fertility services as an essential health service and not as a cosmetic or other less important service. This mandated the presence of robust fertility legislation and lucid policies governing ART activity within countries. Two centres in South Africa recommended that IVF drugs should be put on the essential medicines list because "IVF medication would then be available in state without out of pocket payment." All informants corroborated that insurance coverage for ART procedures by multiple players, including public insurance, was essential. In Algeria, it was suggested that cover by public insurance be widened to include other professionals not just the military and the police forces.

Many centres recommended that governments should subsidise ART procedures. Some proposed the establishment of non-governmental organisations or public-private partnerships with a mandate to source cheaper consumables and lobby for subsidising fees for the patients. Governments were encouraged to allow duty-free importation of ART equipment and consumables, though respondents did not mention if this was standard practice for importation of other medical equipment and consumables. Pharmaceutical companies were urged to "donate medications to some needy public patients".

Others proposed the avoidance of middlemen by directly purchasing drugs and equipment from manufacturers. One respondent suggested that all ART centres in a country should

collaborate and buy from the manufacturer, equipment and consumables in bulk then distribute among themselves. Availability of facilities for purchasing equipment on flexible payment terms allowing repayment over long periods of time would ease the burden of setting up and running a centre. Centres would then be encouraged to ensure cost-effective pricing to allow sustainability ie- not profit-making, but not loss-making. Batching patients would maximise utilisation of ordered consumables before expiry date and minimise wastage. Resources could be conserved by limiting investigations eg-not repeating baseline tests during a subsequent IVF cycle.

The need to relax bureaucratic processes in the purchase of drugs and IVF consumables resonated among many informants who proffered the following mitigating measures. One respondent stated that “ART staff need direct access to decisive hospital management rather than following long vetting paths prior to procurement. There should be a revolving fund for IVF managed by committee members from procurement, accounts, administration, doctors and embryologists who plan what they need, and acquire resources from reputable sources. Although funds are overseen by the hospital management (signing rights), the clinical and technical staff in charge of the ART centre decides what is required”. Drugs for IVF should be kept in the ART laboratory, not the main pharmacy and these should be purchased from the ART unit’s own revolving fund. One centre noted that using different brands of drugs in successive batches on a rotational basis ensured competition amongst suppliers thereby reducing prices and ensuring maintenance of quality.

Human resource was identified as an essential component. Adequate numbers of staff for the work load are required to reduce the waiting periods from diagnosis till treatment, which was about 6 months at Farhat Hached. Having dedicated IVF/ART doctors without other responsibilities was proposed by some. One respondent from South Africa voiced the need to "remove gate keeping obstacles" to allow more doctors and scientists to train as subspecialists in ART and more embryologists to train in ICSI and other ART procedures". It was pointed out that patients have more confidence in the competence of well-trained academic staff in the public sector who take medical responsibility for their actions. Ensuring harmony among co-workers with no acrimony or infighting was reported to increase efficiency.

Several respondents echoed that public ART centres should have good infrastructure, be well equipped, be aesthetically pleasing and offer efficient quality service that is comparable to that in private centres.

Some respondents voiced that all ART services from initial consultation to completion of procedures should be placed under one roof in a dedicated unit. One centre mentioned that limited access to theatre for oocyte retrieval limited the number of patients that they could assist at any given time. They shared theatre with the maternity unit. Therefore since maternity cases were considered more urgent, patients requiring IVF procedures were side-lined.

Appropriate patient selection and earlier referal of the correct patients to ART centres was suggested to lead to better access to treatment.

In order to break taboos, mitigate stigmatisation and encourage patients to seek care, interviewees pointed out that ART centres should implement measures to increase public awareness of fertility and the availability of services for the management of infertility eg- through health talks, including via print and broadcast media. Successes of treatment were recommended to be disclosed to the public eg- through displaying photos of new borns in the ART unit, and publishing good centre specific birth rates.

Chapter 5: Discussion

During phase 1, we obtained responses from 17/27 (63.0%) of countries whose representatives were invited and 19/47 (40.4%) of all invited participants. Public sector ART services were available in 10/18 (55.6%) participating countries (including South Africa), while 24/185 (13.0%) of all identified ART centres were public ART centres. North African countries had the highest concentration of public ART centers versus other regions on the continent. Limited public-private sector collaboration was present in Algeria, Sudan and Tunisia. Factors cited by participants as essential to improve public ART service provision included adequate funding in the form of government subsidies, public-private partnerships and discounted rates for public patients by pharmaceutical companies; skills acquisition; independent budget and management teams for public ART centres; and advocacy to increase awareness of the availability of ART services and their success rates. Factors cited as major hindrances to public ART were bureaucracy; policy and legislative deficiencies; lack of cognisance of the impact of infertility; financial constraints; and lack of equitable distribution of health services.

The response rates that we obtained of 63.0% per country and 40.4% per individual participant after two e-mail reminders were comparable to other online surveys among health care professionals. In a systematic review of 12 internet-based surveys of health professionals, Braithwaite and colleagues found that response rates varied from 9-94%; while it was 54.2% in their own survey of general practitioners after 5 e-mail reminders (24). The lower per individual response rates that we encountered may be because centres chose one participant to represent them, instead of sending several individual responses per

centre. The above acceptable response rates gave us confidence to administer Phase 2 as an online survey.

The presence of public ART services in only 55.6% of participating countries (62.5% of countries providing ART) and 13.0% of all identified ART centres reflected a disparity in access to care biased against individuals of lower socioeconomic status who rely on the public health sector due to the lack of health insurance and the inability to cover costs out of pocket (9). According to the general household survey of South Africa (2018), only 16.4% of individuals had medical insurance, while only 22.6% of households had at least one member on a medical aid scheme (25). A similar trend is likely to prevail in most countries on the continent.

Provision of ART in public centres was concentrated mainly in North Africa in which 5 countries (Algeria, Libya, Morocco, Sudan, Tunisia) had public ART centres as compared to other regions in which only one country provides ART in public centers; Ethiopia in East Africa, Cameroon in Central Africa, Nigeria in West Africa and South Africa in Southern Africa. The first public ART centers that we were informed of were established in South Africa in 1982 (Tygerberg Fertility Clinic) and 1983 (Groote Schuur Hospital Reproductive Medicine Unit), then Tunisia in 1999 (Aziza Othmana ART Center Tunis) and 2002 (Farhat Hached ART Center Sousse). Other countries generally lagged behind, having established ART only in the last decade. Ethical, cultural and religious beliefs as well as the presence of permissive or restrictive legislation have been known to account for variations in regional availability of ART (13,26).

Limited public-private sector collaboration was present in Algeria, Sudan and Tunisia. Public health insurance funded medications for members in Tunisia, while selected public officials in Algeria (police and military) were also funded. We were not given information on the extent of cover in Sudan. The countries in which public insurance covered care in the private sector already had public ART centres available, which may have reflected a permissive operational environment for public-private co-operation as compared to the observed absence of any such arrangement in countries without publicly funded ART.

For Phase 2, responses were obtained from 6 of 10 countries identified to have ART in the public sector; a response rate comparable to that for phase 1. Half of those that returned questionnaires did not consent to an interview, thereby foregoing the opportunity to fully opine. Crucial insights may have been lost. The interviews were in addition to the qualitative in-depth questionnaires. Fourteen of 16 respondents were clinicians; hence their perspectives dominated those of other professionals. The ages of participants ranged from 37 to 67years and the majority had >5 years of experience in ART suggesting they could appropriately discern successes and challenges faced at their institutions.

The utilisation of ART at public centres was low, less than 500 cycles per annum in all countries except the 2 centres in Tunisia which recorded 1150 and 800 cycles per annum at Aziza Othmana and Farhat Hached respectively. The number of treatment cycles appeared inversely correlated to the cost of ART. Tunisia which had the highest treatment cycles offered the cheapest ART cycle with a maximum out of pocket payment of USD 160 mostly because medications for ART were partially to fully covered by public and private insurance (70% and 30% of patients) for 3 cycles. Medications are thus a major cost driver for ART in

the public sector. It is imperative that measures to reduce the cost of medication be adopted. Suggestions by participants included insurance coverage, inclusion of ART medications on the essential drugs list and concessions with pharmaceutical companies to reduce prices. The term "public" in this survey does not mean "free". This survey demonstrated the need for co-payments in most public institutions. Most public health services irrespective of the care rendered will however require some co-payment from users, but it should not be unaffordable in line with the target for SDG goal 3 to protect households from impoverishing health costs (18). The out of pocket component of health care affects health seeking behaviour. Health financing systems that create packages which minimise out of pocket payments are associated with better access to sexual and reproductive health care among all including the poor (20).

Adequate funding was cited as fundamental for boosting ART service provision by all respondents in both phases of the study. Funding is required to build infrastructure; to train and maintain a skilled workforce; to acquire equipment and consumables in the clinics and laboratory; and to maintain consistent power supplies.

Private ART centres which generate profit were more feasible to set up first in all countries. Factors cited as having enabled centres to commence public ART were research results showing a high burden of infertility, university-government institution partnerships, public-private partnerships and perfecting utilisation of other low cost infertility treatments such as ovulation induction with timed intercourse or IUI. The synthesis of data on the burden of infertility guides resource allocation to enable service provision(27). By creating systems to maximise the utilisation of available and affordable medically assisted reproduction, centres

may be better prepared to triage patients and organise themselves to run successful ART programmes.

African governments are often burdened by diseases with an immediate impact on morbidity and mortality, such as HIV/AIDS, malaria, and maternal and perinatal health programs (18). Government resources are exhausted by these programs leaving little for programs to ameliorate infertility. Countries which do not yet have infrastructure for ART services in the public sector may learn from multi-sector cooperation models in other countries that have succeeded. Infertility is non-selective and its negative impact on psychosocial and physical well-being is felt across all social divides (6,7). Neither the private nor the public health sector on its own can manage to solve the problem of infertility (14). Multi-sector cooperation between the public sector, private sector and civil society have been shown to complement each other in solving social problems (15). Civil society may play a role in raising awareness of fertility and infertility and advocacy; the government in crafting and enforcing laws, policies and programmes that respect and protect sexual and reproductive rights (20); while the private sector continues to lead with innovations to make ART available and affordable at a reasonable cost (15).

Being in a heterosexual relationship was a pre-requisite to access ART in the public sector in most countries, except South Africa, while gamete donation was prohibited in Tunisia. Currently WHO recommends universal access to infertility care regardless of sexual orientation or marriage status (27). To continue to exist, centres need to conform to cultural norms within their communities (12), which may account for the strict eligibility criteria in some countries. For centres to adhere to the principles of public health, they must achieve a delicate balance between assuring the health of the community while respecting the rights

of individuals within that community (28). Success of ART approaches futility with maternal age beyond 42years (29) therefore it is plausible on a public health scale to withhold treatment with autologous oocytes beyond that age.

Some centres transferred supernumerary embryos in a bid to cut costs. Data from ANARA documented this trend with a mean number of 2 to 3 embryos transferred in most cycles (30). Retrospective reviews of everyday clinical practice in resource rich countries have shown that elective single embryo transfer (sET) with cryopreservation was associated with a higher term live birth rate and less cost per live birth than double embryo transfer in women under 40years (31–33). Similar benefits may be realised in African public centres if robust cryopreservation facilities are established. Moreover, a 5-year trend analysis by ANARA on sET vs double embryo transfer (dET) showed that elective sET in fresh autologous cycles was associated with a higher clinical pregnancy rate (CPR) of 43.2% vs non-elective sET (16.6%) and all dET (37.3%). Elective dET was associated with only a marginal increase in CPR (<5%) vs elective sET, but increased the multiple delivery rate by 33.4% (30).

While egg sharing assists women who would otherwise not afford ART a chance to conceive, it is associated with ethical dilemmas for the donor such as coercion, psychological concerns should the recipient conceive and the donor does not, a potential reduction in the cumulative live birth rate per started cycle and unwanted contact with donated children in future (34,35). Extensive informed consent is therefore a pre-requisite.

There is an urgent need to explore measures to make ART more affordable so as to ensure universal access. Matsaseng and Kruger described a public-private partnership model which

they practiced involving fewer personnel in order to cut administrative fees; mild ovarian stimulation protocols using clomifene and low dose gonadotropin (FSH dose of 75IU per day for a maximum of 8 doses); and oocyte retrieval without anaesthesia but analgesia (intramuscular pethidine and cervical block) (36).

Initiatives such as the "Walking Egg Project" which incorporates simplified 'one-stop infertility clinics', low cost mild-ovarian stimulation protocols, and simplified IVF laboratory procedures, have been proposed for the developing world, but are still to be validated (37).

Bureaucracy was cited as a significant hindrance to the delivery of ART services in the public sector. Bureaucracy may delay or hinder developmental programs (38). Some respondents indicated that independent management teams and budgets for IVF units may be a solution to improve access to ART by eliminating bureaucracy.

Strengths

This was the first multi-country survey assessing the status of ART in the public sector in Africa. The internet based survey led to a reduction in the financial and logistical burdens of scheduling appointments and travelling across countries in Africa. All regions of Africa, according to the United Nations geoscheme for Africa, (ie- southern, northern, western, eastern and central Africa) were represented in both phases of the survey. Despite COVID 19 related travel restrictions, communication across countries prevailed. Participants could respond to the questionnaire and schedule interviews at their convenience. The questionnaire was offered in both English and French. There was time for participants to research and think critically before reverting to the questionnaire which may have improved the quality of their responses.

The study revealed challenges faced, and lessons learnt by fellow Africans. These may be utilised by others when setting up and sustaining their own public ART centres.

Limitations

The response rate per country was approximately 60%, and 40% per individual. It is possible that some invitations to participate might have been filtered and remained undelivered or relegated to spam folders without reaching the intended participant, or sent to the participant's non-primary email address. During Phase 2 of the study, 7 of 15 participants completed the questionnaire but did not accept the invitation for an interview to expound their opinions. Non-verbal cues were lost. The majority of informants (14/16) were clinicians, and did not heed the request for contact details of additional participants of a different profession from their centres which reduced the diversity of responses. The time frame of this international survey coincided with the first and second waves of the COVID 19 pandemic. This led to a delay of at least one year between phases 1 and 2 of the study as investigators feared non-response by identified informants who could have been overwhelmed with COVID 19 related stresses and additional responsibilities placed on them. Some centres may not have been keen to bare their successes and challenges.

Information regarding when and how some centres were established was not obtained for various reasons, viz, SARA data did not capture year of establishment for South African centres; the request for an interview was not accepted by some; and informants in some centres were not present at the time the centre was established such that they did not have access to this information.

Conclusion

ART services are present in the public sector in Africa, but they are still restricted and riddled by many challenges. The top 3 barriers to the establishment and sustenance of public ART centres are lack of clear policy and legislation; poor funding and bureaucracy. Out of pocket co-payments for ART are unavoidable. The number of ART cycles conducted per annum is inversely correlated to the co-payment. Adopting measures that reduce co-payments is associated with higher utilisation of services. Existing public centres are beacons of hope that other institutions can learn from.

Recommendations for future research

- Exploration of the views of embryologists, nurses and other allied health professionals towards factors which facilitate or limit ART service provision in the public sector
- Development of a network for ART in the public sector which periodically captures utilisation of ART and evaluates promoters and barriers to service provision
- Exploration of the views and opinions of service providers and patients towards egg-sharing IVF as a cost saving measure
- Internal and external validation of initiatives such as the “Walking Egg Project” which incorporates simplified ‘one-stop infertility clinics’, low cost mild-ovarian stimulation protocols, and simplified IVF laboratory procedures

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Appendix 1: Questionnaire Phase 1

The status of assisted reproductive technology in the public health sector in Africa – a multi-country survey

My name is Dr Rumbidzai Majangara Karaga. I am carrying out the above mentioned study in fulfillment of the Masters of Philosophy in Reproductive Medicine Degree with the University of Cape Town, South Africa. My supervisor is Professor Silke Dyer [Director of the African Network and Registry for Assisted Reproductive Technology (ANARA); Board member of the International committee on ART (ICMART); and Deputy Head of Department University of Cape Town Department of Obstetrics and Gynaecology].

We intend to document the current status of assisted reproductive technology (ART) activity in the public health sector or in public-private partnerships on the African continent and assess facilitators and barriers.

We have defined ART based on the International Glossary for Infertility and Fertility Care 2017 which states that "ART involves the in vitro handling of oocytes and embryos and excludes artificial insemination with the partner's or donor sperm". For the purposes of this study, public centres will include the following: public hospital, public university based, mission/ faith-based, and not for profit NGO based clinics or hospitals. Public-private ART partnerships will include all partnerships in which third party funders (governments, publicly funded medical aid schemes) cover ART treatment for eligible patients in private ART centres. We hope that lessons learnt may be used to widen access to ART in Africa.

The study will have two phases. In this first phase we are collecting quantitative information on public ART facilities or public-private partnerships in Africa. In the second phase we will collect qualitative information from key informants of public ART centres or those involved in public-private partnerships.

If you are willing to participate, please connect via the unique web-link to an online survey system below. It will take you about 20minutes to complete the questionnaire, but you have a week to collect information that is not readily available to you. If there is no response from you after one week, we will send you 2 reminders to complete the survey. You are free not to answer any of the questions.

Final results of the study will be available to you. Subject to the degree of input and collaboration, we may offer co-authorship during publication in keeping with international authorship guidelines. You have the right to insist that your personal information not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, know about your involvement in this research. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

We take your willingness to participate in the online survey and provide us with the requested information as being indicative of your informed consent.

Should you have queries about any aspect of this study, please contact Rumbidzai Majangara Karaga on +27677594385 or email, majangararumbie@gmail.com. For concerns about the way in which the research has been conducted, you may contact Silke Dyer on email, silke.dyer@uct.ac.za. For ethical concerns, contact the Human Research Ethics Committee in the Faculty of Health Sciences at the University of Cape Town on +27214066338 or email, hrec-enquiries@uct.ac.za

On line survey Phase 1:

Thank you for agreeing to participate in '**The status of assisted reproductive technology in the public health sector in Africa – an international survey'**

1. Please state the country you work in_____

2. Please enter your age in completed years:_____

3. How many years have you worked in the field of assisted reproductive technology?
    a. <5
    b. 6-10
    c. 11-15
    d. 16-20
    e. >20

4. Your current job description is (please tick all that apply)
    a. fertility doctor
    b. fertility nurse

c. embryologist or biologist
d. leader of a national or regional fertility society
e. data manager
f. head of ART centre
g. head of national ART data registry
h. other (please explain) …….

5. Are you working in a
   a. Public ART centre or clinic?
   b. Exclusively private ART centre or clinic?
   c. A private ART centre or clinic that also provides service to patients supported by public funding?

6. What is the total number of centres that provide ART services in your country? (enter number)_____

7. How many of the ART centres in your country are found in the following settings?
   a) private hospital or clinic based _____
   b) public hospital _____
   c) public-university hospital _____
   d) mission/ faith-based hospital _____
   e) Not for profit non-governmental organisation based (NGO) clinic/ hospital _____ Please state the type of NGO
   f) Other, please explain _____

8. In your country, are there public-private partnership models where public funds, such as National health schemes, fully or partially fund access to ART in the private sector? Please explain…….

9. If there are public ART centres in your country, please document the type of public centre, year of establishment, and the known or estimated number of ART cycles conducted per annum in each public centre in the table below. Please remember that by public centres we mean any of the following: public hospitals, public university based, mission/ faith-based, and not for profit NGO based clinics or hospitals. You may add more rows to the table to fit more centres.

Name of public centre	Type of Public centre	Year of establishment	Number of ART cycles per annum

10. Please list the top three factors that in your opinion would promote or improve access to publicly funded ART in your country
    i. …….
    ii. …….
    iii. …….

11. Please list the top three causes that limit the delivery of ART in the public sector in your country
    i. ……
    ii. …….
    iii. ……..

We thank you for your participation and for providing this valuable information.

Appendix 2: Questionnaire French Version

État des techniques de procréation assistée dans le secteur de la santé publique en Afrique - une enquête multi-pays

Je m'appelle Dr Rumbidzai Majangara Karaga. Je suis en train de mener à bien l'étude mentionnée ci-dessus dans le cadre de la maîtrise en médecine de la reproduction avec l'Université de Cape Town, en Afrique du Sud. Mon superviseur est le Professeur Silke Dyer [Directrice du Réseau et du Registre africains des techniques de procréation assistée (ANARA); Membre du conseil d'administration du comité international des traitements antirétroviraux (ICMART); et chef de département adjoint au département d'obstétrique et de gynécologie de l'Université du Cap].

Nous avons l'intention de documenter l'état actuel des activités liées aux technologies de procréation assistée (ART) dans le secteur de la santé publique ou dans le cadre de partenariats public-privé sur le continent africain et d'évaluer les facilitateurs et les obstacles.

Nous avons défini le traitement antirétroviral sur la base du Glossaire international des traitements de l'infertilité et de la fécondité 2017, qui stipule qu '«un traitement antirétroviral implique la manipulation in vitro d'ovocytes et d'embryons et exclut l'insémination artificielle avec le sperme du partenaire ou du donneur». Aux fins de cette étude, les centres publics comprendront les éléments suivants: hôpital public, cliniques basées dans des universités publiques, confessionnelles / confessionnelles et non lucratives. Les partenariats public-privé sur les ARV incluront tous les partenariats dans lesquels des bailleurs de fonds tiers (gouvernements, régimes d'aide médicale financés par des fonds publics) couvrent le traitement antirétroviral des patients éligibles dans des centres privés. Nous espérons que les leçons apprises pourront être utilisées pour élargir l'accès au traitement antirétroviral en Afrique.

L'étude aura deux phases. Dans cette première phase, nous collectons des informations quantitatives sur les installations publiques de traitement antirétroviral ou les partenariats public-privé en Afrique. Au cours de la deuxième phase, nous collecterons des informations qualitatives auprès d'informateurs clés de centres de traitement antirétroviral publics ou de personnes impliquées dans des partenariats public-privé.

Si vous souhaitez participer, veuillez vous connecter via le lien Web unique à un système de sondage en ligne ci-dessous. Il vous faudra environ 20 minutes pour remplir le questionnaire, mais vous disposez d'une semaine pour collecter des informations qui ne

vous sont pas facilement accessibles. S'il n'y a pas de réponse de votre part après une semaine, nous vous enverrons 2 rappels pour répondre au sondage. Vous êtes libre de ne répondre à aucune des questions.

Les résultats finaux de l'étude seront à votre disposition. Sous réserve du degré de contribution et de collaboration, nous pouvons proposer la co-rédaction lors de la publication conformément aux directives internationales en matière de rédaction. Vous avez le droit d'insister pour que vos informations personnelles ne soient enregistrées nulle part et que personne, à l'exception du chercheur et des membres identifiés de l'équipe de recherche, ne soit au courant de votre participation à cette recherche. Un numéro de code ou un pseudonyme sera attribué à vos réponses. Les données, les publications ou autres méthodes de rapport de recherche telles que les comptes rendus de conférences vous seront référés de cette manière.

Nous prenons votre volonté de participer au sondage en ligne et nous fournissons les informations demandées à titre indicatif de votre consentement éclairé.

Si vous avez des questions sur l'un des aspects de cette étude, veuillez contacter Rumbidzai Majangara Karaga au +27677594385 ou par courrier électronique à majangararumbie@gmail.com. Pour toute question concernant la manière dont la recherche a été menée, vous pouvez contacter Silke Dyer par courrier électronique à l'adresse silke.dyer@uct.ac.za. Pour des raisons éthiques, contactez le Comité d'éthique de la recherche sur les humains de la Faculté des sciences de la santé de l'Université du Cap au +27214066338 ou par courrier électronique à l'adresse hrec-enquiries@uct.ac.za.

Enquête en ligne Phase 1:

Merci d'avoir accepté de participer à «L'état des techniques de procréation médicalement assistée dans le secteur de la santé publique en Afrique - une enquête internationale»

1. Veuillez entrer votre âge en années complètes: _____

2. Depuis combien d'années travaillez-vous dans le domaine des technologies de procréation assistée?

une. <5

b. 6-10

c. 11-15

ré. 16-20

e. > 20

3. Votre description de poste actuelle est (veuillez cocher toutes les cases appropriées)

une. médecin de fertilité

b. infirmière en fertilité

c. embryologiste ou biologiste

ré. dirigeant d'une société de fertilité nationale ou régionale

e. gestionnaire de données

F. responsable du centre d'ART

g. responsable du registre national des données sur les ART

h. autre (veuillez expliquer) …….

4. Travaillez-vous dans un

une. Centre ou clinique public de traitement antirétroviral?

b. Centre ou clinique d'ART exclusivement privé?

c. Un centre ou une clinique privé d'ART qui fournit également des services aux patients bénéficiant d'un financement public?

5. Quel est le nombre total de centres fournissant des services de traitement antirétroviral dans votre pays? (entrer un nombre)_____

6. Combien de centres de traitement antirétroviral dans votre pays se trouvent dans les paramètres suivants?

a) hôpital privé basé _____

b) clinique privée de médecins _____

c) clinique à praticien unique _____

d) hôpital universitaire privé _____

e) hôpital public _____

f) hôpital public universitaire

g) hôpital missionnaire / confessionnel _____

h) Clinique / hôpital à but non lucratif (ONG), clinique / hôpital _____ Veuillez indiquer le type d'ONG

i) Autre, veuillez expliquer _____

7. Dans votre pays, existe-t-il des modèles de partenariat public-privé dans le cadre desquels des fonds publics, tels que des systèmes nationaux de santé, financent totalement ou partiellement l'accès aux ARV dans le secteur privé? S'il vous plaît, expliquez…….

8. S'il existe des centres de traitement antirétroviral publics dans votre pays, veuillez indiquer le type de centre public, l'année d'établissement et le nombre connu ou estimé de cycles de traitement antirétroviral réalisés chaque année dans chaque centre public dans le tableau ci-dessous. Rappelez-vous que par centres publics, nous entendons l'un quelconque des éléments suivants: hôpitaux publics, cliniques basées dans des universités publiques, confessionnelles ou confessionnelles, et à but non lucratif. Vous pouvez ajouter plus de lignes à la table pour s'adapter à plus de centres.

Nom du centre public	Type de centre public	Année d'établissement	Nombre de cycles de TAR par an

9. Veuillez énumérer les trois principaux facteurs qui, selon vous, favoriseraient ou amélioreraient l'accès aux ARV financés par l'État dans votre pays

je. …….

ii. …….

iii. …….

10. Veuillez énumérer les trois principales causes qui limitent l'offre de traitements antirétroviraux dans le secteur public de votre pays.

je. ……

ii. …….

iii. …….

Nous vous remercions de votre participation et de ces informations précieuses.

Appendix 3: Questionnaire Phase 2

My name is Dr Rumbidzai Majangara Karaga. I am carrying out the above-mentioned study in fulfillment of the Master of Philosophy in Reproductive Medicine Degree with the University of Cape Town, South Africa. My supervisor is Professor Silke Dyer [Director of the African Network and Registry for Assisted Reproductive Technology (ANARA); Board member of the International Committee on ART (ICMART); and Deputy Head of Department University of Cape Town Department of Obstetrics and Gynaecology].

We intend to assess facilitators and barriers to the availability of assisted reproductive technology (ART) services in the public health sector on the African continent with the help of participants from public ART centers or those involved in public-private partnerships. We hope that lessons learnt may be used to widen access to ART in Africa.

We have defined ART, based on the International Glossary for Infertility and Fertility Care 2017 which states that "ART involves the in vitro handling of oocytes and embryos and excludes artificial insemination with the partner's or donor sperm". For the purposes of this study, public centers include the following: public hospitals and public university-based clinics or hospitals. Public-private ART partnerships include all partnerships in which third party funders (governments, publicly funded medical aid schemes) cover ART treatment for eligible patients in private ART centers.

If you are willing to participate, please complete the questionnaire attached to this email. It will take you about 20 minutes to complete the questionnaire, but you have a week to collect information that is not readily available to you. If there is no response from you after one week, we will send you 2 reminders to complete the survey.

Final results of the study will be available to you. You have the right to insist that your personal information not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, know about your involvement in this research. Your answers will be given a code, number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

We take your willingness to participate in this survey and provide us with the requested information as being indicative of your informed consent.

Should you have queries about any aspect of this study, please contact Rumbidzai Majangara Karaga on +27677594385 or email, majangararumbie@gmail.com. For concerns about the way in which the research has been conducted, you may contact Silke Dyer on email, silke.dyer@uct.ac.za. For ethical concerns, contact the Human Research Ethics Committee in the Faculty of Health Sciences at the University of Cape Town on +27214066338 or email, hrec-enquiries@uct.ac.za

Phase 2 Survey:

Thank you for agreeing to participate in '**The status of assisted reproductive technology in the public health sector in Africa – a multi-country survey'**

12. Please state the country you work in:

13. Please enter your age in completed years:

14. How many years have you worked in the field of assisted reproductive technology?
    - ☐ <5
    - ☐ 6-10
    - ☐ 11-15
    - ☐ 16-20
    - ☐ >20

15. Your current job description is (please tick all that apply)
    - ☐ fertility doctor
    - ☐ fertility nurse
    - ☐ embryologist or biologist
    - ☐ leader of a national or regional fertility society
    - ☐ data manager
    - ☐ head of ART center
    - ☐ head of national ART data registry
    - ☐ other (please explain)

16. Please enter the name of the institution/ ART center that you are representing.

17. What is the estimated number of ART cycles conducted per annum at your institution?

18. Do you have patient selection criteria for eligibility to access ART at your institution?
    ☐ Yes ☐ No
    If yes, please explain (e.g. women's age, number of children, geographic location, etc)

19. What is the average cost of an IVF or ICSI cycle at your institution? (USD).

20. Please explain how patients managed at your institution are funded.
    ☐ private insurance
    ☐ public insurance
    ☐ out of pocket funding

21. Please estimate the proportion of patients using each type of funding.
    Private insurance
    Public insurance
    Out of pocket funding

22. Please state which of the treatments below are covered by insurance. State the level of cover insurance confers (eg- full or partial cover. Include the number of ART cycles covered).
    a) medications for IVF and cryopreservation cycles
        Covered by insurance: ☐ Yes ☐ No
        If yes, ☐ Full cover ☐ Partial cover
        Number of cycles covered
    b) surgical procedures pre-ART
        Covered by insurance: ☐ Yes ☐ No
        If yes, ☐ Full cover ☐ Partial cover
    c) ART procedures- IVF, ICSI
        Covered by insurance: ☐ Yes ☐ No
        If yes, ☐ Full cover ☐ Partial cover
        Number of cycles covered

23. Please explain in detail what measures, if any, have been put in place to make ART more affordable and accessible at your institution.

24. Please list and explain in detail, the top three factors that in your opinion would promote or improve access to public-funded ART at your institution.
    iv.
    Explanation:
    v.
    Explanation:
    vi.
    Explanation:

25. Please list and explain in detail, the top three causes that limit the delivery of public-funded ART at your institution.
    iv.
    Explanation:
    v.
    Explanation:
    vi.
    Explanation:

We thank you for your participation and for providing this valuable information.