

Affordable ART services in Africa: synthesis and adaptation of laboratory services

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The aim of this paper is to provide information, opinions and suggestions on affordable laboratory-orientated fertility screening and treatment. Resource management to provide such services in developing countries, basic and advanced assisted reproductive services and assisted reproduction treatment (ART) of patients with sexually transmitted infections are addressed. Alternative viewpoints and parallel thinking should be encouraged to synthesize and adapt first-world ART guidelines and recommendations into safe and workable directives for developing regions. Affordable African ART programmes, devoid of commercialism, can provide essential sexual health screening services en route to safe fertility services for human immunodeficiency virus type-1 (HIV-1) serodiscordant couples (male HIV-positive), who wish to have their own biological child.

Keywords: affordable; Africa; assisted reproduction; semen decontamination; HIV-1

Introduction

Treatment for the infertile couple in a first-world setting evolved rapidly through access to high technology procedures and equipment, ready-made culture media and the finest monitoring systems in a controlled environment. A very different scenario however, shapes the lives and future of individuals, as well as health workers from the developing countries. Barriers to reproductive treatment are mostly financial in nature, influenced by regional, ethnical, social and political aspects. The question arises if past, present or alternative reproductive procedures can be applied and utilized within a simplified and, therefore affordable, assisted reproduction programme in developing countries? Furthermore, how the complex relationship between infertility and HIV-1, especially in Sub-Saharan Africa would direct or influence such a programme?

The reproductive profile, affordability of care and resources available within the region will determine the selection of fertility screening procedures, as well as 'new reproductive technologies' treatment programmes. The aim of this paper is to provide information, opinions and suggestions on affordable laboratory-orientated fertility screening and treatment. Three sections will be discussed, i.e. basic and advanced laboratory assisted reproductive services, resource management to provide such services in developing countries and assisted reproduction treatment (ART) of patients with sexually transmitted infections in developing countries.

Assisted reproduction care in developing countries

Workforce expertise, physical and financial resources available, together with the general sexual health profile of patients in a developing region, will determine the prospective reproductive care models. It is accepted that the political stability within the region, public support and a certain level of infrastructure, must be available to support reproductive healthcare deployment.

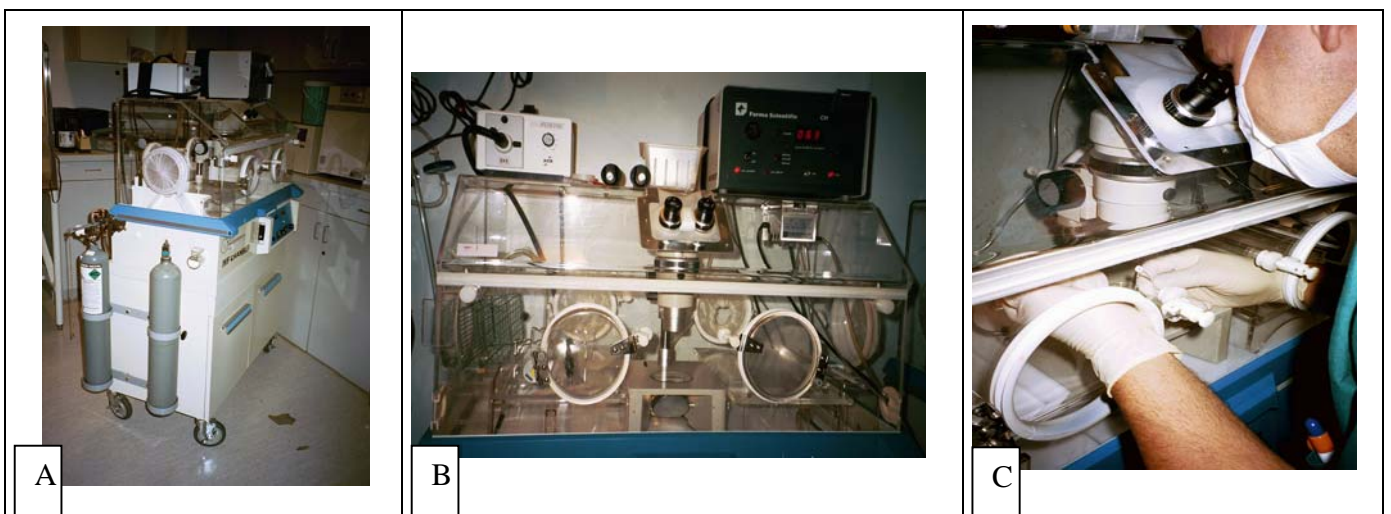
(i) Levels of reproductive care

Existing health services should either be remodelled or new amenities within a region could be created, to facilitate different levels of healthcare. Three levels of care are presently applicable, i.e. (i) a large number of primary centres/clinics performing initial inexpensive diagnostic fertility assessments, including a basic semen analysis and screening for viral diseases; (ii) a smaller number of intermediary practices that should offer screening and essential reproductive healthcare treatments and (iii) tertiary care centres providing advanced assisted reproductive technologies within an established academic setting.

A simple semen analysis, as part of a ‘basic affordable fertility’ work-up, is mandatory for couples seeking fertility treatment in a developing country (Ombelet and Campo, 2007). This evaluation according to the latest edition of World Health Organization (WHO) guidelines should include macroscopic and microscopic assessment together with a basic semen culture (World Health Organization, 1999). Equipment, such as light microscopes, micropipettes, counting chambers and disposables including a small bio-flow/enclosed micro-chamber or ‘humidicrib’, to perform basic semen analyses are fundamental and simple (see Figure 1) (Pilcher, 2006) to pipette semen samples and to safeguard the operator.

Figure 1: Adaptation of an Isolette.

A. Side view B. Front View C. Loading an embryo transfer catheter (Photos taken at Dallas In vitro associates, dallas, Texas, 2002).



An intermediary or secondary facility could extend basic service provision to include fundamental sperm preparation techniques and intra-uterine inseminations (IUIs) (Ombelet *et al.*, 2003). Microorganisms, non-sperm cells, cell detritus, senescent and immature sperm should all be removed during sperm preparation, retaining only quality sperm. Basic sperm processing preparation techniques, such as the conventional swim-up procedure is easy to perform, inexpensive and recovers a good fraction of highly motile spermatozoa. Glass-wool filtration is slightly more costly, but provides a good yield directly from the ejaculate, eliminates leucocytes and reactive oxygen species and is relatively easy to perform (Henkel and Schill, 2003). ‘Tertiary care centres’ can provide either sophisticated services with high-technology equipment, or use basic equipment and culturing techniques generally employed in a veterinary setting. Alternatives for laminar flow cabinets include the use of a ‘humidicrib’ (Pilcher, 2006), replacement of a water-jacketed incubator with a modular incubator chamber (www.thermo.com/forma), or use of the sealed-bag culture method (Pilcher, 2006). A dish containing the embryos can be placed inside special plastic bags, or a circular modular incubator, and purged with a pre-mixed gas mixture to create a mini-incubator. The bags can be placed in a water bath and the modular chamber inside a warm oven or incubator. Expensive gas manifolds are not needed, and gas tanks running empty or incubator malfunctioning are avoided with this system (Bavister and Poole, 2005). Present technology, alternatively, can perhaps be adapted for the use in a clinical *in vitro* fertilization (IVF) setting in Africa. Smaller modular bench-top-like K-MINC (Cook Co., Australia) incubators, ‘simple’ media specifically formulated to be easy to use with an extended shelf-life, should be investigated. Pilot studies and/or surveys are needed to validate alternative techniques, and to determine the views of African-females on participating in alternative protocols. The use of devices that reduce the requirements for sophisticated laboratory equipment such as the INVOcell™, an intra-vaginal culturing capsule (Bonaventura *et al.*, 2006) should be considered, once the device is tried and accepted in economically developed countries.

The application of ICSI techniques and cryopreservation as part of tertiary care centres has important financial and management implications. Cryopreservation should only be considered if the physical security of the vessels, specimens and liquid nitrogen supply as well as staff-safety could be secured. Patients should be screened for sexual transmitted infections (STIs); sperm purified and stored in hermetically sealed ionomeric resin straws (CryoBioSystems, CBS™) to safeguard cryopreservation conditions (Tomlinson, 2005). Networking and collaboration between regional assisted reproduction units should minimize costs through the acquisition of consumables in bulk, whereby batch quality could be compared and stock or equipment shared between laboratories. A mobile reproductive healthcare service could also optimize scarce resources, such as micromanipulators, through basic screening and treatment of patients in groups at set days/weeks. Intra- and inter-region networking, training and continuous quality control is especially important when technological advanced techniques and equipment are used during assisted reproductive treatments. The embryology special interest group of the European Society for Human Reproduction and Embryology (ESHRE) (Gianaroli *et al.*, 2000) could provide a best practice quality control framework to guide established or future IVF laboratories worldwide. Adaptation of these guiding principles together with

the clinical quality guidelines and indicators (Mourad *et al.*, 2007) should be considered for different subfertility levels of care, taking into account the existing healthcare system and socio-cultural beliefs of a developing country.

(ii) Training

Existing training courses (Franken *et al.*, 2000; Björndahl *et al.*, 2002) could be adapted and customized into three practical and theoretical courses, i.e. a basic primary screening level that includes a semen analysis; an intermediary level including semen processing techniques and IUI, and a third advanced level that includes most assisted reproduction techniques. However, knowledge exclusivity and exorbitant costs (with regards to monetary exchange rates) to attend international meetings and workshops are a reality for embryologists from developing countries, who do not enjoy conference sponsorships from companies. This could change if on-line peer-reviewed educational support for continuous learning in spermatology, embryology and related procedures is freely available. Condensed theoretical and practical information should be readily available in atlas-formats, and health workers from developing countries should have free on-line access to international applicable recommendations and guidelines of ART procedures and methodologies. The introduction of inter-continental regional 'twinning' of reproductive facilities could further provide assistance and support.

Access to peer-reviewed meetings can also be aided through charging of minimal or no registration fees to selected applicants from developing countries to attend WHO or ESHRE training, pre-congress courses and conference proceedings. Another possibility is to extend the annual ESHRE award to include a specific category at entrée level to enable the presentation of data at a meeting. Abstracts for the presentation could be selected, extended abstracts requested and power point presentations or posters could be peer-reviewed for presentation at the annual meeting. An ESHRE taskforce training sponsorship could also support deserving health workers to visit dedicated European ART Units, or reproductive specialists from interest groups (Alpha Scientists for Reproductive Medicine/Centres for Reproductive Assistance Techniques to HIV-1-seropositive Individuals in Europe (CREAThE) network) could organize different training courses at functional African ART units. Furthermore, a supportive network of mentors and the implementation of continuous training and quality control programmes, through dedicated ESHRE taskforces, could strengthen collaboration and support.

(iii) Obstacles

Barriers to provide basic or advanced reproductive technologies in developing regions (Van Balen and Gerrits, 2001) are numerous and complex. Notwithstanding financial and logistic difficulties, evaluations and treatments should meet the requirements of the patient and the environment, e.g. ~25% of males participating in our local assisted reproduction programme are unable to provide semen samples at the Unit. Options to provide a home-collection and/or use non-toxic polyurethane condoms are therefore offered to some patients. Inadequate transportation of patients and medical goods, antiretroviral (ARV) therapy and drugs that are not freely available, sub-optimal storage conditions and/or shortages of consumables and disposables, unavailability of adequate laboratory facilities (with specific reference to air quality, aseptic conditions and

uninterrupted power supply), and inexperienced reproductive specialists, are highly relevant in some regions. Access to consumables, stable electricity supply to the laboratory and working within a dust and disaster free laboratory environment, should not be taken for granted in some developing regions. Therefore, back-up systems, laboratory consumables with a long shelf-life, durable equipment and applicable quality control assurance mechanisms should be adapted and implemented to alleviate the restricted access to reproductive care.

Advanced reproductive technologies also require patients to understand and comply with prescriptions for medications and instructions and must be on time for appointments. Unrealistic expectations or misunderstanding of processes and procedures by patients will cause a high voluntary or involuntary dropout rate. In addition, patient's attitudes and lack of knowledge will result in the provision of incorrect sexual history and males may choose not to be part of the evaluation process. Repeated tests and investigations may be performed on the female partner, finally to discover that the couple's infertility was due to a male factor (Leke, 2005).

Resource management for effective ART management in developing countries

Various internal and external resources should be considered, i.e. human, physical, financial, organizational and operational resources, to initiate spermatology and embryology-associated procedures. It is accepted that expectations, knowledge, needs, and norms of the regional community, wherein prospective reproductive healthcare centres will operate, must be the central focus to determine the format of prospective services.

Special support, by trained local counsellors, will be needed at healthcare centres for couples living with HIV-1 or those patients with failed assisted reproduction attempts, especially in the locations where infertility and/or HIV are stigmatized. In addition, gender and professional inequalities in developing communities could have medical and social implications for infertility treatment. It is the author's opinion that special attention should be given to the training and retention of paramedical staff within the African continent. Nursing staff, counsellors and biomedical scientists and technologists are most likely to be female, while clinical staff tends to be male, and will reflect the same gender, income and class, as well as influential position, in some developing societies. Experienced clinical embryologists and spermatologists who are not academically motivated, or who do not have a strong personal belief in the goals of the reproductive health centre, will either be part of the 'brain-drain' to developed countries (at present) and in future, lured financially into large pathology enterprises operating within the continent, or employed by gynaecologists in private assisted reproduction practices. Motivation through training opportunities and research initiatives, recognition and long-term goals, such as career path development, should however, provide a framework to retain creative, energetic and goal-orientated health workers (Mortimer and Mortimer, 2005).

Financial support of assisted reproductive procedures in developing countries remains a contested issue (Ombelet and Campo, 2007). Assisted reproduction laboratory techniques as part of the 'new reproductive technologies' treatment can, however, be considered by some as prohibitively expensive and difficult to implement in developing countries (Inhorn, 2003). Ombelet and Campo (2007) outlined a custom-designed cost-effective infertility care programme as an alternative approach, i.e. utilizing assisted reproductive technologies complementary to family planning and perinatal care programmes in developing countries. Care should be taken that proper financial guidelines are available and regular audits are in place, together with proper legislation and official authorized documentation to guide fertility management. Patients as well as healthcare workers will be vulnerable without legal protection. Many African countries currently do not have guidelines or official national reproductive health policies to regulate or control assisted reproduction services or practitioners, or to ensure the safety of laboratory staff and patients when treating patients with chronic viral diseases. In addition, the commercialization of gametes and embryos and exploitation of resource poor communities within a developing region could jeopardize and tarnish the integrity of current reproductive healthcare initiatives.

Treatment of patients with STIs in developing countries

Although information on STIs and infertility management in Africa is inadequate and scarce (Leke, 2005), most international health strategies focus predominantly on the decline of population growth (Van Balen and Gerrits, 2001). There are many obstacles to the management of not only infertility, but also to implement appropriate screening and treatment of patients with STIs on the African continent.

Globally, HIV infections are geographically unequally distributed. The majority of infections occur in Sub-Saharan Africa (15.4 million individuals), South and East Asia (7.1 million individuals). HIV-1 group M, with strains A, C and D together with two circulating recombinant forms, dominates the African epidemic. The HIV-2 epidemic remains limited and is located in West Africa, but is believed to be less infectious and pathogenic than HIV-1 (McCutchan, 2006). Besides HIV, the most common STIs reported in Africa include chancroid, human papilloma virus, herpes simplex, trichomoniasis and candidiasis, while gonorrhoea, syphilis and chlamydia also contribute to damages of Fallopian tubes (Bambra, 1999). Local infections of the male reproductive tract may also impact on HIV-1 shedding and thus the HIV load in semen (Dejucq-Rainsford and Jégou, 2004). The possible origin, clinical presentation and transmission through semen of other sexual transmitted agents, such as cytomegalovirus (CMV), Hepatitis B, C, D (HBV, HCV, HDV) and human T-lymphotrophic virus (HTLV-I) have been reviewed elsewhere (Dejucq-Rainsford and Jégou, 2004; Elder *et al.*, 2005). Sub-Saharan Africa is reported to have the highest HCV prevalence rate in the world, compared with European and North American populations (Madhava *et al.*, 2002). The mode of hepatitis transmission and implications for infertile patients as well as health workers have also been described in detail by the Practice Committee of the American Society for Reproductive Medicine (2006).

(i) Screening of patients, laboratory adaptations and risk reduction

The risk to introduce infectious conditions into the laboratory can be reduced through the screening of patients and health workers for various infectious agents. Routine testing of patients will reduce the risk of infections in the ART laboratory. Testing should be governed by the prevalence of the disease in a specific patient population, medical history and physical examination of both partners (Elder *et al.*, 2005). Should patients with STIs qualify for ART, then post-test counselling should be provided as well as a referral to facilities equipped to handle infectious body fluids. Patients should be persuaded to know their HIV status with the understanding that participation in ART implies agreement to disclose their status to the participating partner (ESHRE Ethics and Law Task force, 2004). Various national and international guidelines stipulate that patients should be tested annually for Hepatitis B and C (HBV/HCV). Screening for HIV-1 and -2 should be performed within 3–6 months of initiating a treatment cycle, to permit time for seroconversion. Screening for HTLV-I, which is endemic in central Africa, and general genital infections should be assessed within the context of the patient population (Elder *et al.*, 2005; ASRM Practice Committee, 2006a,b). Viral reproduction, adaptations and intermittent shedding within the male genital tract (Pillai *et al.*, 2005), as well as the concomitant occurrence of several viruses or sexual transmitted pathogens, have important implications for sperm washing procedures and viral detection methods.

The ASRM Ethics Committee (2002) and ASRM Practice Committee (2006a,b) recommend health practitioners to counsel patients infected with a sexually transmissible pathogenic virus on the potential risks of transmission and to recommend the safest procedures for conception and delivery. They also stated that fertility services could not deny treatment to individuals with chronic infections if a centre has the resources to provide care. Inclusion criteria for ART in HIV-1-infected persons, results after treatment and the impact of ARV treatment on male and female fertility are discussed in detail by Van Leeuwen *et al.* (2007). It is, however, more complex to accommodate patients with chronic viral infections in an ART programme in a developing country, without all the necessary first-world resources. Only a very small number of South African units have separate laboratory facilities, dedicated equipment and/or cryocontainers and staff trained in semen decontamination procedures (for details on ART laboratory adaptations and safety, see Englert *et al.*, 2004; Gilling-Smith *et al.*, 2005). Several South African ART centres without such facilities are, however, treating HIV-1-infected patients using universal precautions. Questions therefore arise as to the frequency with which persons (with blood-borne viruses) approach ART centres seeking assisted reproduction, as well as the strategies that are in place to deal with such cases. A survey of South African infertility centres (Mphele, 2006) brought to light a number of worrying findings. There is a high probability of patients with undiagnosed HIV receiving ART without the knowledge of healthcare practitioners. This possibility raises significant ethical and legal concerns. The survey, which was conducted in 2003–2004, demonstrated that some ART centres in South Africa treat HIV/HCV infected patients yet they lack facilities, skills and protocols that include risk reduction measures. Routine screening of both partners for HIV prior to ART were generally performed once during the couples' first attempt. Hepatitis B and C viral testing was however, seldom performed. We anticipate that a follow-up survey will indicate a change in attitude, policies and communication within

ART units, due to HIV/acquired immune deficiency syndrome (AIDS) awareness campaigns in South Africa, as well as strong international views of compulsory and specialized approaches when handling specimens from ART patients who are HIV infected. At present, 32% of all new HIV-1 infections and AIDS deaths globally occurred in Southern Africa in 2007, with the largest number of HIV-1 infections recorded in South Africa (UNAIDS & WHO on-line report, 2007). These findings emphasize the need for relevant expertise and the development of applicable affordable laboratory protocols, as well as risk reduction strategies within the African continent that comply with internationally accepted safety standards. An affordable solution (within the African-context) would be to separate patients that tested (HIV/HCV) positive and negative in time, if space and funds are lacking (Devaux *et al.*, 2003; Gilling-Smith *et al.*, 2005).

All laboratory procedures should be performed in a Class 2 biosafety cabinet with vertical flow, using sterile disposables and aseptic techniques and appropriate equipment to reduce the risk of infection (Elder *et al.*, 2005). The cross-contamination incident of HBV that leaked from straws in a liquid nitrogen tank (Tedder *et al.*, 1995) emphasized the importance of container selection and sealing system, for cryopreservation of gametes and embryos (Letur-Könirsch *et al.*, 2003). The safety of heat-sealed shatterproof CBS™ ionomeric resin straws for the cryopreservation of semen containing HCV (Maertens *et al.*, 2004) and HIV-1 RNA (Letur-Könirsch *et al.*, 2003) have been demonstrated. Separate tanks to house straws containing gametes and embryos from seropositive patients would provide additional security (Devaux *et al.*, 2003; Gilling-Smith *et al.*, 2005). ART centres should always consider risks to other patients and staff when treating patients with known infections. Even if universal precautions are practised, zero risk does not exist (Gilling-Smith *et al.*, 2005).

(ii) Semen decontamination

Contamination in a laboratory setting can occur through patients and health workers, specimens, such as semen, supplies and through the environment. Poor hygienic conditions, inadequate maintenance, cleaning and waste disposal may increase the risk of infection transmission to equipment, health workers, patients, gametes and embryos (Elder *et al.*, 2005). All assisted reproduction techniques should reduce the risk of viral transmission to the uninfected partner, offspring, medical staff and other non-infected patients treated in the same laboratory. Adoption and the use of donor sperm are two reproductive options that are available for viral carriers seeking ART (ASRM Ethics Committee, 2002; Bujan *et al.*, 2007). These options may, however, not be culturally or for religious reasons acceptable in many regions of the developing world (Van Balen and Gerrits, 2001; Inhorn, 2003).

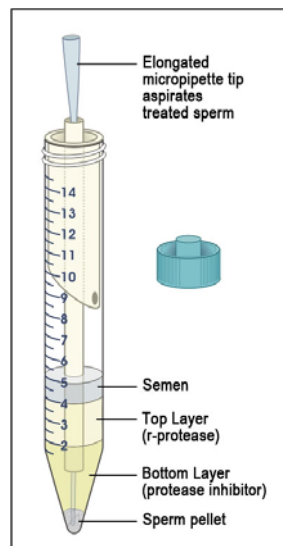
The ultimate sperm separation and washing method should be simple, performed in a short time, be cost-effective, resulting in the harvesting of a highly motile fraction without causing sperm damage or non-physiological changes to the separated fraction. Non-sperm cells, as well as dead spermatozoa and harmful decapacitating factors should be removed during sperm processing (Henkel and Schill, 2003). It is clear that the type, origin, viral load and nature of infected cells in semen will, however, impact on the efficiency of a specific sperm washing procedure (Dejucq-Rainsford and Jégou 2004;

Elder *et al.*, 2005; Fiore *et al.*, 2005). The choice, as well as proven efficiency of a density gradient (Kuji *et al.*, 2008) and washing technique (Fiore *et al.*, 2005; Loskutoff *et al.*, 2005; Kato *et al.*, 2006) must be well established before any attempt can be made to perform semen decontamination for ART treatment. Agreement, however, has not been reached on the presence of HIV-1 DNA in sperm and the possible adherence of viral particles to the sperm plasma membrane. Muciaccia *et al.* (2007) confirmed the presence of HIV-DNA in purified sperm samples by nested PCR and *in situ* PCR after chromatin decondensation. A recent retrospective multicentre study by the CREAThE network (Bujan *et al.*, 2007), however, demonstrated the efficiency of sperm-washing techniques in HIV-1-serodiscordant couples during different ART procedures. These researchers are of opinion that the technique can possibly be part of a worldwide health initiative to combat HIV in developing countries. The question arises whether the application of the above is of relevance with regards to reproductive treatment of HIV-infected patients in a developing country. Semen and purified samples are usually couriered to pathology laboratories in major cities (in South Africa) for viral validation using commercial assays, with small volumes undergoing only a quantitative RNA test. Results are usually received within 24–72 h depending on transport distances. Sperm washing procedures (density gradient purification, with washing and swim-up steps) to eliminate the virus can also result in low number of sperm influencing the choice of ART procedure. IVF or ICSI using frozen spermatozoa can therefore be performed once the negative status of the sperm sample is confirmed. Special attention should also be given to motivate and train naïve laboratory-staff that are not accustomed to handle potentially infected biological material (especially semen and follicular fluids from HIV-1-positive patients). Furthermore, a revised minimum standards document for practices that offer ART (Practice Committee of the Society for Assisted Reproductive Technology and the Practice Committee of the American Society for Reproductive Medicine, 2006) in developing countries could be used to assist with the specialized training of laboratory-staff, record keeping and basic information on informed consent and ethical aspects. From the above, it is clear that semen decontamination should be performed in only specific dedicated ART laboratories in developing countries, with access to reputable viral validation assays. These laboratories should have the dedicated facilities and staff should be trained to treat patients with STIs (Englert *et al.*, 2004; ESHRE Ethics and Law Task Force, 2004; Gilling-Smith *et al.*, 2005). Units that aspire to treat HIV-infected individuals should collaborate and interact with ART Units experienced in the treatment of such patients, according to international safety standards.

Our Unit gained insight in the semen decontamination procedure through benchmarking and experimentation over time. Using a centrifuge tube insert (ProInsert-15™, Nidacon; Figure 2) combined with a discontinuous density gradient containing a recombinant serine protease and inhibitor (PureSperm® Pro Top and Bottom Layer, Nidacon), we have illustrated that HIV-1, HCV and CMV and white blood cells can be removed from spiked semen samples (Loskutoff *et al.*, 2004, 2005; Huyser *et al.*, 2006). Recent (unpublished) results indicated that the insert also removed various bacteria concentrations efficiently when compared with traditional density gradient centrifugation. Semen samples were spiked with a range of bacteria (Coagulase negative staphylococci, *Staphylococcus aureus*, *Enterococcus faecalis*, *Enterobacter* species, *Escherichia coli* and *Candida*

albicans) that were commonly cultured in samples during diagnostic semen analyses. The design of the insert facilitated precise layering of density gradients and semen, allowing access to the treated sperm pellet post-centrifugation directly, without exposure to the upper gradient layers with possible pathogens and cell debris. The addition of recombinant protease to the density gradient ameliorated the viral infectivity, augmented sperm velocities and had no negative impact on sperm vitality. Most importantly, potential contaminated layers can be tightly capped within the conical tube and discarded after use.

Figure 2: Schematic presentation of a conical test-tube with a ProInsert-15TM and density gradient layers after centrifugation of seminal plasma. An elongated micropipette is inserted through an inner channel and bypass contaminated layers.



When evaluating seminal HIV-1 RNA and DNA viral loads of HIV-infected males, we observed a large disparity between blood and semen viral loads. A patient receiving ARVs can, e.g. present with >25x higher viral RNA levels in semen than in blood. We were able to confirm the removal of elevated (>8x10⁶ copies/ml) seminal viral loads with negative quantitative (HIV-1 RNA reverse transcriptase polymerase chain reaction [RT-PCR]) and qualitative (proviral DNA RT-PCR) tests after the decontamination procedure at our laboratory.

It would therefore be advisable to adopt a HIV/ART policy for African Units that no ART can be performed if the viral load in semen is ≥10 000 RNA copies/ml (Pasquier *et al.*, 2006) and >1x10⁶ white blood cells/ml present in semen (World Health Organization, 1999). However, financial constraints and logistics will probably preclude viral-validations of most seminal and possibly purified sperm samples in most African ART laboratories. Therefore, an undetectable or low blood viral load with ARV therapy,

together with a robust semen decontamination procedure that is repeatable, easy to perform, cost-effective and safeguards the patient, as well as the operator, should be promoted for the African continent.

Conclusion

It is well known that unhindered access to information, reproductive health screening and associated therapies are of primary importance to address inequities between the developing and developed worlds. A recognized cohesive Euro-African partnership could further empower developing regions within the African continent to launch, sustain or expand existing reproductive health programmes. Integrating established academic-orientated reproductive laboratories from within the continent as partners to communicate, support and validate upcoming reproductive health screening centres, could further strengthen and provide intra-continental supportive networks. Regional partnerships can utilize and transfer indigenous knowledge and possibly link resources to the benefit of the continent. Matching inter- and intra-continental ART expertise and requirements to the benefit of African countries will be the bedrock of reproductive healthcare development on the continent. Past, present and validated alternative reproductive procedures can be applied within a controlled environment in developing countries. Simplified and therefore, affordable assisted reproduction programmes can be achieved through the design of three levels of reproductive care, with the first and second levels providing basic semen analyses and screening for STIs, and IUI procedures, respectively. Tertiary levels of ART care should be associated with selected academic institutions, using basic equipment and culturing techniques. Cryopreservation and micromanipulation procedures should be offered including possible treatment of patients with STIs. This possibility relies on the infrastructure of the surroundings and the accessibility to reliable pathology services to support ART procedures.

Affordable ART services are attainable in Africa, if an African ‘brain-drain’ could transform into an African ‘brain-bank’, to support and promote scientific knowledge and talent within the continent. Alternative viewpoints should be encouraged to synthesize and adapt first-world ART guidelines and recommendations into safe and workable directives for developing regions. Participation in a continuous quality assurance programme, data monitoring and training are essential to establish efficient ART laboratories in developing countries. The relationship between infertility and HIV/HCV, especially in Sub-Saharan Africa should receive special attention through networking with ART Units experienced in treating HIV/HCV-infected persons. Evidently, the economic and demographic impact of HIV/AIDS on the African continent should be counteracted through counselling, knowledge dissemination and proactive services to predominantly resource poor Africans. Affordable African ART programmes, devoid of commercialism, can provide essential sexual health screening services en route to safe fertility services for HIV-serodiscordant couples (male HIV-positive), who wish to have their own biological child.

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