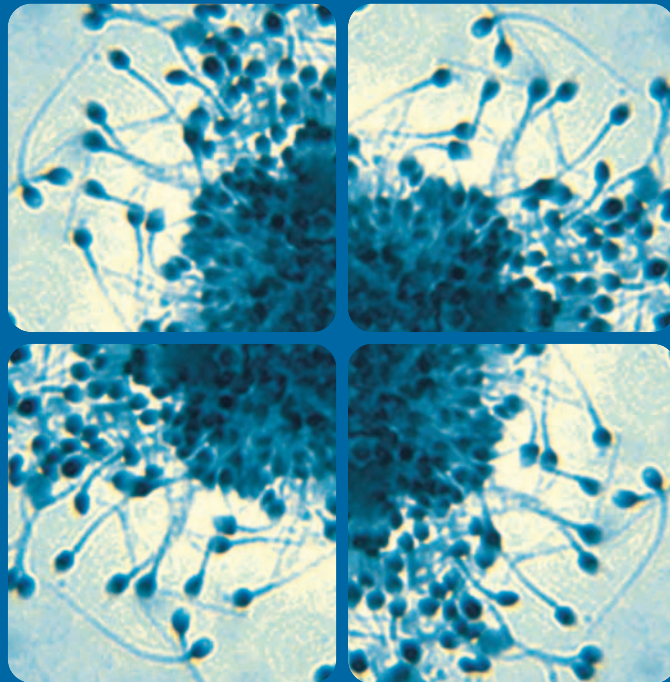


The
Royal Society
of **Edinburgh**



Reproductive Health



Report of a Conference
organised by the
The Royal Society of Edinburgh and the
Caledonian Research Foundation
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Reproductive Health

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The Royal Society of Edinburgh would like to thank the following people and organisations:

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INTRODUCTION

Reproductive issues have major health and social consequences worldwide. This two-day conference, which attracted some of the leading international figures in the field, focused on the key areas of contraception, fertility and assisted conception, cancer, sexual behaviour and HIV/AIDS.

Key messages

- Reproductive health is of the utmost importance at a global, national and individual level
- There is real need for new contraceptive methods that are easier to use, more effective and safer than existing methods
- There are a number of promising avenues for developing new contraceptives, but these will stall without funding, determination and political will
- Any new method will also have to have additional health benefits such as protection from reproductive cancers or HIV
- Reproductive cancers (including cervical, breast, ovarian, testicular and prostate cancers) are a serious cause of illness and death in men and women and are a major public health problem in the developed world
- Understanding the reproductive system and how reproductive cancers occur is key to finding new treatments
- Infertility is a growing problem
- Women must be encouraged not to delay childbirth because fertility diminishes throughout their 20s then decreases dramatically from the age of 35
- Current assisted reproductive treatments are expensive, access to them is poor and cannot overcome the decline in fertility with age
- By avoiding unplanned pregnancy in HIV-infected women, contraception is an important way of preventing transmission of the virus from mother to infant
- Scientists are hopeful that treatments such as microbicidal gels to help reduce the risk of HIV transmission will soon be available
- Vaccines to protect against the virus associated with cervical cancer (HPV) and genital warts are at an exciting stage of development
- Although men and women are having sex earlier and with more people, the abortion rate has remained relatively stable
- However spectacular the scientific advances, much of reproductive health depends on human behaviour and on the political will and economic capacity to deliver services

SESSION 1: OVERVIEW

Professor Anna Glasier, Director of Family Planning & Well Woman Services at NHS Lothian Primary Care Division; School of Clinical Sciences and Community Health, the University of Edinburgh and the Department of Public Health Policy, London School of Hygiene and Tropical Disease.

From Population Control to Reproductive Health Issues for the Developed World.

Professor Glasier covered three main themes: what is reproductive health, why it is important and how we can improve it?

She described the historical context from the first birth control clinic (Dr Alette Jacobs in Amsterdam in 1882) through government family planning programmes in the developed world in the last century. To define reproductive health, she used a statement from a WHO Bulletin of 2000, saying it was about preventing and treating disease, supporting normal functions such as pregnancy and childbirth, reducing adverse outcomes of pregnancy and enabling people to have safe and fulfilling relationships and decide if and when to have children. It is also about 'life-enhancing processes and how to nurture them in the face of adversities such as gender discrimination, exploitation, conflict and economic disruption'.

She also quoted the 'pillars' of reproductive health, including the status of women, family planning, safe motherhood, abortion,

infertility and sexual behaviour.

The importance of reproductive health is backed by statistics. Worldwide there is wide variation. HIV/AIDS is pandemic in sub-Saharan Africa but not in the developed world. More than one in four women in South Africa is HIV positive, for example. Maternal mortality is much higher in the developing world (2,300 deaths per 100,000 live births in Rwanda compared to 10 in 100,000 in the UK)

In the UK, women are having sex earlier and having more partners and the incidence of sexually transmitted diseases such as genital warts (which are caused by a virus implicated in cervical cancer) and Chlamydia is rising. Incidence of reproductive cancers is also increasing, apart from cervical cancer because of the success of the national screening programme. The focus of contraception services shifted over the last century from population control to providing a means of family planning. There are also social, cultural and political issues around contraception.

Professor Glasier talked about the oral contraceptive pill, saying it was cheap, highly effective and widely used but pointing out that women do not take it perfectly and that many (a third of new users in the US after six months) give up taking it, partly due to side effects.

Professor Glasier ended by talking about Japan, where introduction of the pill was delayed **until 1999 (after the introduction of Viagra!)**. She attributed delays to factors including caution about new drugs, opposition from

gynaecologists doing abortions and concerns about falling population. Although the contraceptive pill is now available, she said access was difficult because women were given only three months' supply at a time and had to undergo vaginal examinations each time.

Professor David T Baird CBE FRSE,

Emeritus Research Professor in Reproductive Endocrinology, Centre for Reproductive Biology, the University of Edinburgh; Chairman of the Caledonian Research Foundation.

Targets for New Contraceptives

Professor Baird presented the case for new contraceptives on a worldwide and national scale. Globally there are 300 million couples without access to effective contraception, 50 million abortions per year and 500,000 maternal deaths per year; nationally there are 200,000 abortions per year (UK) and 30 per cent of births are unplanned. In addition, at an individual level, people would appreciate a wider choice of contraceptive.

He outlined barriers to increasing contraceptive prevalence including political, cultural and religious factors, lack of funding and limited choice of contraceptive method. There are specific difficulties in 2004: the market for new products is unknown, pharmaceutical companies have to be convinced of the cost benefits, it's challenging to introduce new products which will be used in healthy people and there are cheap, safe, relatively effective methods with some health benefits already available.

As our understanding of the reproductive system grows, several opportunities for new contraceptives or improving existing methods have been identified. These include new ways of delivering current contraceptives, such as patches and gels to deliver hormonal protection and new methods such as a once-a-month pill that inhibits implantation, and hormonal contraception for men. Some of these are already at an advanced clinical stage and have been shown to be effective in trials. For example, using Mifepristone mid-cycle has been shown to be a highly effective once-a-month contraceptive pill.

In the longer term there is also the possibility of targeting other parts of the reproductive system, such as using phosphodiesterase inhibitors to stop oocytes (eggs) maturing or finding ways to stop sperm being made or reaching maturity. In order to convince pharmaceutical companies of the benefits of investing in this area, and to encourage uptake and continued use, it will be necessary to ensure that new contraceptives have additional health benefits either short term (such as weight loss, preventing dysmenorrhea (period pain), improving libido, benefits such as preventing sexually transmitted diseases or, in the long term, reducing risks of common serious diseases such as breast or prostate cancer or cardiovascular disease.

Professor Steve Smith, Principal, Faculty of Medicine, Imperial College London.

A Systems Approach to Drug Discovery in Reproductive Health

Professor Smith spoke about trying to find novel compounds which might be used as contraceptives through systems biology or bioinformatics – that is, using computer and mathematical modelling to answer biological questions. He said computer programmes are a valuable tool in finding likely candidates for carrying out specific functions and can cut down radically on work done *in vitro* and in animal models. Whilst it is relatively expensive, systems biology is a good way of establishing the relative worth of molecules and identify those it is worth following up. He talked of looking at patterns of genes to predict outcomes and compare the way they would act.

Professor Smith described one study of endometrial function, which could have important contraceptive implications. He said the systems approach identified pathways which could be exploited to change endometrial function.

The systems approach, however, requires close working between a number of disciplines, including physics, molecular biology and mathematics, but that it is important in developing predictive, preventative and personalised medicine. He also said the biotech approach is interesting pharmaceutical companies.

Professor Hilary OD Critchley, Professor of Reproductive Medicine, the University of Edinburgh.

The Uterus as a Contraceptive Target: Current Methods and Mechanisms

Professor Critchley described the importance of the uterus as a contraceptive target, pointing out that the endometrium (womb-lining) is already the target of a number of contraceptives, including the combined oral contraceptive pill (COCP), implants, the progestogen only pill (POP) and intrauterine devices (IUD), including levonorgestrel-releasing devices such as Mirena. She said the uterus plays a crucial part in reproduction and that the endometrium went through well-defined hormone-dependent cycles (of regeneration then degradation).

She described how the current methods work, their effectiveness and benefits and disadvantages. For example, the COCP is known to protect against endometrial cancer for up to 15 years after the woman stops taking it and progestogen-only contraceptives cause some women to have breakthrough bleeding, which many find unacceptable.

She said progesterone antagonists have great potential as a contraceptive which would address breakthrough bleeding. Current research indicates that they would be effective as a low-dose pill which was likely to induce amenorrhea (absence of periods) – an effect which research shows would be acceptable to women.

Discussion around contraception

Dr Richard Anderson, clinical scientist with the MRC, asked whether introduction of the pill in Japan was motivated by individuals, NGOs or commercial interests. **Professor Glasier** said that all had been involved but that she did not believe it would have been introduced if it hadn't been for the swift licensing of Viagra.

Professor John Collins, McMaster University, Canada, asked if different strategies were required for the developing and developed worlds. **Professor Glasier** said there were more issues around availability in the developing world because of uncertainty of supply and poor infrastructure. **Professor Robert Millar**, director of the MRC Human Reproductive Sciences Unit at Edinburgh University, asked if contraception was moving down the agenda as sexually-transmitted infections (STI's) moved up. **Professor Glasier** said that much funding was going to STIs, particularly HIV/AIDS and that there were some who considered it to be unethical to develop a new contraceptive method which did not protect against HIV/AIDS.

Professor Millar asked whether potential health benefits of new contraceptives would 'fire up' the interest of pharmaceutical companies in developing them. **Professor Baird** believed that was so, saying it would be attractive to develop a contraceptive which protected against breast cancer and improved on nature. This was followed up by **Professor Hilary Critchley** of Edinburgh University who asked if the way forward was to approach development of new products through associated health benefits.

Professor Baird agreed and was backed up by **Professor Glasier** who gave the example of a new oral contraceptive which had proved very popular because it appeared to help women lose weight.

Prof Valerie Beral, Head of the Cancer Research UK Cancer Epidemiology Unit in Oxford, pointed out that there would be significant interest in any product which protected against breast cancer.

Professor Andre Van Steirteghem, Vrije Universiteit Brussel, asked why the WHO was not more interested in supporting contraceptive research. **Professor Glasier** blamed George W Bush, a dwindling in other funds and a reduction of interest in contraception.

Prof Allan Templeton of Aberdeen University asked why the abortion rate wasn't going down in this country where there is more choice and better access to contraception. **Professor Glasier** said we couldn't be complacent because current methods were the 'best of a bad lot'. She compared contraception research with developing new forms of insulin for diabetes, saying that researchers hadn't stopped with pig insulin just because it 'worked pretty well' but had developed better, human insulin.

SESSION 2: INFERTILITY

Professor Allan Templeton, Department of Obstetrics and Gynaecology, the University of Aberdeen; President, Royal College of Obstetricians and Gynaecologists.

Human Infertility – Prevalence, Prevention and Management

Around 15 per cent of couples experience infertility and, in eight per cent, it will remain unresolved. There may be a number of factors in this, including the rise in Chlamydia infection which can lead to pelvic inflammatory disease and infertility. However, an important factor is likely to be women delaying childbirth. The age of the women, how long they have apparently been infertile and whether they have had a previous pregnancy are important predictors in considering whether women will get pregnant following treatment or not.

Women's fertility declines dramatically after the age of 35. Older women are also less likely to become pregnant after assisted conception treatment such as IVF. Assisted conception technologies are expensive to administer and have social and ethical dilemmas. Recent NICE (National Institute for Clinical Excellence) guidelines have cleared up some uncertainties around treatment and recommended that treatment of varicocele in men and mild endometriosis in women are ineffective.

Professor Templeton said eligible couples should have access to several attempts at

treatment but recommended that only one embryo should be replaced per cycle of IVF to prevent twins – at the moment in the UK the limit is two.

Dr Kate Hardy, Institute of Reproductive and Developmental Biology, Imperial College London; Hammersmith Hospital.

Gamete Quality

Dr Hardy agreed that the key problem of infertility is that women are delaying childbearing. The average age of having a first baby is now 30 and fertility declines with age. In addition, the risk of having a chromosomally abnormal baby increases dramatically with age.

Life expectancy is increasing but the age of the menopause remains around 50 – in reality, women's fertility has diminished by 10 years earlier.

Studies have shown that genetic abnormalities tend to originate in the oocyte (egg). Women are born with their full complement of oocytes and these deteriorate with age, apparently making them more vulnerable to chromosomal abnormalities. We need to understand more about the genetic, physiological and environmental factors which affect the decline in egg quality. If the trend towards late motherhood continues, other ways may have to be found, such as freezing ovarian tissue or embryos at a younger age.

She said education was vital and pointed out

that high-profile pregnancies by women in their 40s, such as Madonna and Cherie Blair, are giving women a false sense that it was okay to delay. She also said politicians should make it easier to have children earlier – for example, by introducing changes to working practices.

Professor John Collins, Department of Obstetrics and Gynaecology, McMaster University, Canada.

Limits of Assisted Conception

A number of factors limit the impact of assisted reproduction on infertile couples. These include access to expensive services, limited success rates of treatment (partly due to declining fertility with age), limited tolerance of couples to the intensity of treatment and the availability of alternative solutions such as overseas adoption.

An IVF treatment cycle cost ten per cent of annual household expenditure (around £2,000) in Europe and is even more prohibitive in the developing world.

Countries should aim to have 1500 cycles per million couples per year which would mean that around 50 per cent of infertile couples received treatment. In Europe the figure is presently more like ten per cent. As a result too few infertile couples have access to treatment, even in developed countries, and factors such as age limited success. More research is needed to find the true causes of infertility and develop better treatments.

Professor Andre Van Steirteghem, Centre for Reproductive Medicine, Research Centre Reproduction and Genetics, Vrije Universiteit Brussel (Dutch-speaking Brussels Free University).

Concerns about Assisted Conception

The optimum outcome of assisted conception is the birth of a healthy (singleton) child. Multiple birth is a major drawback of all forms of ART (assisted reproductive treatment) including ovulation induction, IVF and ICSI (Intracytoplasmic sperm injection).

Very few reliable data on outcomes are available even although Louise Brown (the first child born through IVF) was born in 1978. It is difficult to do the studies, which should include pregnancy, delivery and health of the child at birth and in later life. Funding is hard to get. Other areas which should be investigated are the effects of freezing and thawing embryos and procedures where the zona pellucida is interfered with, such as preimplantation genetic diagnosis which requires removing cells from the embryo.

With ART, particularly ICSI, there is an increased risk of chromosomal abnormalities (both inherited and new *de novo*), a higher risk of prematurity and low birth weight and there may be an increase in rare diseases such as genomic imprinting disorders. While prospective parents shouldn't be alarmed, they should be informed of the risks.

Discussion around infertility

Professor Collins asked why we hadn't discovered more genetic causes of infertility. **Professor Templeton** said work is ongoing but that it is a difficult area because families are needed for genetic research. **Professor Stephen Hillier**, professor of Reproductive Endocrinology at the University of Edinburgh asked about the potential impact of the environment. **Professor Templeton** said it might be contributing to falling sperm counts but that this didn't seem to be causing infertility. **Professor Andre Van Steirteghem**, Vrije Universiteit Brussel, asked about pre-implantation diagnosis to screen out genetic abnormalities but **Dr Hardy** said this was not worth doing unless there was a strong reason to suspect a genetic abnormality. **Professor Beral** asked why Israel had such a high rate of assisted conception (1,675 per million couples per year). **Professor Collins** replied that the government had introduced policies to ensure more births, such as free treatment programmes.

SESSION 3: REPRODUCTIVE CANCER

Professor Valerie Beral,

Head of the Cancer Epidemiology Unit,
Cancer Research UK, Oxford.

Hormones and Cancer

Hormones, including progesterone as well as oestrogens, play a central role in causing reproductive cancers, including breast, ovarian, endometrial and cervical cancers. Women are exposed to hormones through hormonal contraceptives, HRT, ovarian activity and pregnancy. In theory hormones should also hold the key to prevention and treatment.

Professor Beral summarised the evidence for the effect of oral contraceptives and HRT on reproductive cancers and concluded that epidemiological data were providing important new information which could be used in prevention. In particular, she described the work of the Collaborative Group on Hormonal Factors in Breast Cancer which showed past pill or HRT use meant no increased risk while current or recent users have an increased risk of developing the disease.

She said different risks should be investigated. For example, combined oestrogen and progestagen therapies in menopause treatments cause a greater risk of breast cancer than oestrogen-only therapy but the opposite is true with endometrial cancer. She also said the role of pregnancy hormones in protecting against breast cancer needed more

investigation so that the mechanism could be understood.

Dr Patricia L Morris,

Senior Scientist, Population Council,
The Rockefeller University, New York.

Profiling Hormones, Receptors and Cofactors in Reproductive Tissues: Physiology, Pharmacology and Dysregulation

Tumours in organs which respond to hormones such as the breast, prostate, ovary, adrenal and thyroid glands may respond to hormone therapy or intervention to act against hormones.

Although our knowledge of hormonal control of proliferation and differentiation in animals is improving, factors regulating these processes in humans are less well understood.

We know that human breast cancers which are not receptive to oestrogen have a poor prognosis, while those which are receptive to the hormone can respond well to endocrine therapy. Using model systems such as immortalised breast cancer cell lines, a better understanding of the molecular mechanisms regulating proliferation can be obtained.

Dr Morris said more information about how hormones act on different parts of the reproductive system should help improve our understanding and find new treatments and preventative therapies.

Dr Charles JN Lacey FRCP,

Reader in Infectious Diseases,
Hull York Medical School, University of York.

Immunisation against Cervical Cancer

We are at an exciting stage of finding a vaccine to protect against cervical cancer. Two pharmaceutical companies are trialling products which look likely to be successful and should be available soon. The vaccines protect against the main types of human papillomavirus (HPV) which is the causative factor in cervical cancer and in genital warts.

While there is optimism about these vaccines, there are concerns around how available they will be and whether they will be made part of the national immunisation programme. New vaccines are treated with suspicion in the UK and there are always concerns about giving vaccines to a healthy population. It could also take potentially 40 years before the benefits were seen in public health terms. But the cervical screening programme, although effective, is expensive and vaccination may be more acceptable to women. The question remains of when to vaccinate. For example, should all women be vaccinated before they become sexually active? Should young men be vaccinated as well? There are also questions around whether a vaccine will protect women from becoming reinfected. There will also be issues in the developing world around cost and access to the vaccine.

Professor Richard Sharpe, MRC Human Reproductive Sciences Unit, University of Edinburgh.

Fetal Development and the Commonest Disorders of Male Reproductive Health

Professor Sharpe presented the case for a Testicular Dysgenesis Syndrome (TDS), saying that basic disorders of reproductive health have a common origin in fetal life.

He said basic disorders of the development and function of the reproductive tract were common in young males. These include congenital defects such as cryptorchidism, hypospadias, testicular germ cell cancer (the most common cancer in young males the incidence of which is increasing) and low sperm count.

Professor Sharpe said there was good evidence that all these conditions could stem from fetal life when the Sertoli and Leydig cells – both important in reproductive health – were formed. He said there was growing evidence that any factors that interfere with androgen production or action could interfere with Sertoli cell proliferation and that maternal lifestyle factors, such as smoking during pregnancy, could have a permanent effect.

Discussion around reproductive cancers

On the subject of a cervical cancer vaccine, **Professor Beral** said that if an HPV vaccine could protect against reinfection, then

it wouldn't take 40 years to see a benefit. **Dr Robin Shattock**, Reader in the Department of Infectious Diseases at St George's Hospital Medical School, London, asked if the vaccine would remain effective for long enough if it was given to girls at the age of 11. **Professor Lacey** said there could be a later booster.

Dr Ailsa Gebbie, Consultant in Community Gynaecology with NHS Lothian, expressed concern at HRT being vilified after 50 years of experience which had given some idea of risk, whereas relatively untested therapies were now being given in preference for osteoporosis.

SESSION 4: BEHAVIOURAL AND SOCIAL DETERMINANTS OF REPRODUCTIVE HEALTH AND HIV/AIDS

Professor Kaye Wellings,

Director, Reproductive and Health Research,
Department of Public Health and Policy,
London School of Hygiene and Tropical
Medicine.

Sexual behaviour in 2004

Professor Wellings presented some of the findings from the first and second British National Surveys of Sexual Attitudes and Lifestyles (NATSAL 1990 and 2000). The studies provided the data to examine trends in sexual behaviour over the past five decades. The main findings include the fact that the age of first intercourse has decreased and the median age is now 16 (compared to 21 for women and 20 for men in the 1930s and 17 for men and women in the 1970s). The findings also show greater sexual 'competence' – the proportion of teenagers having unprotected first intercourse has continued to decline.

The data show that the AIDS epidemic coincided with an increase in condom use which has been maintained. They also show that more women and men are reporting concurrent relationships, which put them at higher risk of sexual ill health.

Dr Robin Shattock,

Reader, Department of Infectious Diseases,
St George's Hospital Medical School, London.

Vaginal Microbicides to Prevent HIV-1 Transmission

There are 14,000 new HIV infections every day, more than 95 per cent are in developing countries and 80 per cent are due to heterosexual transmissions. There is a real need to develop alternative prevention strategies, particularly to protect women who often cannot control sexual encounters or insist on condom use.

It has become clear that the lower reproductive tract (in women the vagina) is particularly vulnerable to the HIV infection. Vaginal microbicides, topical agents such as gels or creams, which inhibit infection with HIV, are a promising development. There are several such preparations in phase II and III clinical trials but recent advances have potential for more sophisticated therapies.

The potential impact is huge. Even if a 60 per cent efficacious microbicide was introduced into 73 low income countries and used by only 20 per cent of women this would avert 2.5 million HIV infections over three years in women, men and infants.

Dr Ward Cates,

Family Health International
Research Triangle Park, North Carolina.

Contraception in an Era of HIV

Dr Cates reviewed published and unpublished literature to describe the effects of contraceptive use on HIV transmission. He concluded that contraceptive use is the 'best kept secret in HIV prevention'. Most couples choosing contraception are not infected. Increased testing and better availability of anti-retroviral therapy in the developing world will allow more couples to know their HIV status and make decisions accordingly. Couples have different contraceptive needs depending on HIV status and whether they want to have a family.

While consistent and correct male condom use provide good protection against HIV, not everyone uses them in this way. Spermicides offer no protection. IUDs offer no protection but do not carry an increased risk (over no contraception) of HIV transmission. There is some concern that hormonal contraceptives may increase the risk of HIV transmission.

Research indicates that providing effective contraception for HIV-infected women who do not wish to become pregnant prevents more infants becoming infected than the use of anti-retroviral therapy. He also said that couples both found to be uninfected should have the 'be faithful' message emphasised because they had found a 'safe haven'.

Discussion around sexual behaviour and HIV

Dr Gillian Penney, Department of Obstetrics and Gynaecology at the University of Aberdeen, said she was encouraged that there is light on the horizon in sexual health because of exciting developments in vaccines and microbicides and the emergence of practical guidance on disease prevention. **Professor Beral** hoped the future might involve combined contraceptives and anti-retrovirals.

Professor Baird pointed out that contraception was cheaper than other anti-AIDS strategies.

Asked whether people told the truth when asked about sexual behaviour, **Professor Wellings** said that you could never be sure but, in the second NATSAL (National Survey of Sexual Attitudes and Lifestyles) study, respondents had been encouraged to type their own answers into a laptop which was thought to improve reporting accuracy.

She was also asked (by **Dr Janet Tucker**, senior researcher with the Dugald Baird Centre for Research on Women's Health, University of Aberdeen) about the study's Chlamydia rates, which were lower than other studies had found. **Professor Wellings** said that only half the respondents had been asked to have a test and that not all agreed, which meant it was not entirely representative. She added that some of the interviewers had not been enthusiastic about it either, which could have been a factor.

On microbicides, **Professor Glasier** asked if it would be better to wait for the more promising products rather than risk disenchantment with the first to come to market. **Dr Shattock** said he thought that advances would be so rapid that the timing gap would not be great.

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The Caledonian Research Foundation (CRF)

The Caledonian Research Foundation is a Scottish charitable company limited by guarantee and has supported independent research in Scotland since 1990. Originally established in 1977 as a spinout from a scientific research organisation and as a charity, the emphasis of its activities changed in 1990 and its interest now lies mainly in sponsoring and encouraging research in Scotland. The Governors of the Foundation include senior figures active in the Scottish academic and business communities. In seeking to achieve its aim of promoting research of international standard in Scotland, it supports a number of Research Fellowships in the Biomedical Sciences, European Visiting Research Fellowships in the Humanities, Postgraduate Scholarships, an International Conference of the Royal Society of Edinburgh and awards an annual Prize Lectureship.



The Royal Society of Edinburgh (RSE)

The Royal Society of Edinburgh is Scotland's National Academy of Science and Letters. An independent body with charitable status, its multidisciplinary fellowship of 1,400 men and women of international standing represents a knowledge resource for the people of Scotland. Committed to its Royal Charter of 1783 for the "advancement of learning and useful knowledge" the Society recognises the important role it can play in today's Scotland. Working as part of the UK and within a global context, the RSE seeks to contribute to Scotland's social, economic and cultural wellbeing by:

- ◆ organising conferences and lectures for the specialist and for the general public on topics of national and international importance
- ◆ providing independent, expert advice to key decision-makers in Scotland
- ◆ awarding over £1.5million annually to Scotland's top young academics to promote research in Scotla
- ◆ enabling leading Scottish-based researchers to collaborate with the best of their international counterparts
- ◆ inspiring school children in classrooms from the Borders to the Northern Isles and promoting their interest in science, society and culture.

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