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Foss, AM; Watts, CH; Vickerman, P; Heise, L (2004) Condoms and prevention of HIV - Are essential and effective, but additional methods are also needed. *BMJ*, 329 (7459). p. 185. ISSN 1468-5833 DOI: 10.1136/bmj.329.7459.185

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screening or choose particular treatments.^{9, 10} Vaccinating some people in a population may cause others (for example, immunocompromised people) to become sick through the spread of the vaccine virus or, conversely, to remain well through the effect of herd immunity.

The existence of collateral health effects and the fact that each individual may be connected to numerous others, including relatives, friends, neighbours, and co-workers, implies developments in research and policy. To explore such effects, new datasets and methods will be needed. Most prospective cohort studies and randomised controlled trials today include only individuals who are followed to observe outcomes. Some social science and epidemiological cohort studies do ask individuals about the health status of their spouse or some other social contact, but only a few (for example, the US health and retirement survey) actually include the spouse or other social contacts in the study cohort. Developing datasets with such features and measurements is necessary to understand fully collateral health effects. Collecting information about the various contacts of people enrolled in clinical trials or epidemiological studies may represent an extension to study design similar to the extension in the 1990s of including cost effectiveness analyses as a standard feature of clinical trials.

Network phenomena are receiving increased attention in fields as diverse as engineering, biology, and sociology,^{11, 12} but they are also relevant to health and medicine. Networks have emergent properties not explained by the constituent parts and not present in the parts. Understanding such properties requires

seeing whole groups of individuals and their interconnections at once. The existence of social networks means that people and events are interdependent and that health and health care can transcend the individual in ways that patients, doctors, policy makers, and researchers should care about.

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Competing interests: None declared.

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Condoms and prevention of HIV

Are essential and effective, but additional methods are also needed

Promotion of condoms has been a mainstay of HIV prevention policy. Over the past few years, however, the value and effectiveness of condoms have increasingly been called into question. The growing "abstinence only" movement in the United States questions the provision of condoms as part of the policy and messaging of the US Agency for International Development (USAID) and claims that condoms have had little to do with the successes achieved in reducing HIV in countries such as Uganda.¹⁻² Senior officials in the Roman Catholic Church also continue to argue about the morality of condom use and dispute its efficacy.³

But what does the evidence tell us? A recent review from the National Institutes for Health says that condoms are protective against HIV infection,⁴ reducing the probability of HIV transmission per sex act by as much as 95% and reducing the annual HIV incidence in serodiscordant couples by 90-95% when used consistently.⁵ However, the impact of inconsistent use of condoms is less substantial: a meta-analysis found that condom use of variable consistency among serodiscordant couples reduced the annual HIV incidence by 69%.⁶ This illustrates how the protection

provided by a condom is dependent both on its efficacy against HIV transmission per sex act and the consistency with which it is used. This is intuitive, yet the consistency of condom use is less commonly factored into scientific and policy debate.

Evidence from around the world highlights the extent to which patterns of condom use are influenced by the form of partnership in which they are being used. Interventions can achieve substantial increases in the use of condoms in commercial and casual sex partnerships. Several studies report high levels of condom use after interventions in commercial sex.⁷⁻⁹ But even in settings where HIV infection is widespread, the use of condoms in primary partnerships remains low—representative surveys of women in 13 African countries found that fewer than 7% report condom use in the last sex act with their regular partner.¹⁰ Surveys of sex workers in Asia generally find that, although many use condoms with their clients, fewer than 40% report using condoms in their last non-commercial sex act. Unless one partner knows they are HIV positive or

feels substantially at risk, interventions generally have limited success at achieving consistent use of condoms in primary partnerships.¹⁰

These low levels of use are in part due to problems of supply, access, and affordability: Shelton et al estimated that 724 million condoms (an average of five condoms per man) were distributed in sub-Saharan Africa in 1999—excessively low for a region ravaged by the HIV epidemic.¹¹ The limited availability of condoms reflects the failure of HIV prevention to go to scale—the 2003 progress report from the joint United Nations programme on HIV/AIDS (UNAIDS) on the global response to the HIV/AIDS epidemic concluded that only a fraction of people at risk of contracting HIV have meaningful access to basic prevention services.¹² Improvements in the supply and distribution of condoms are likely to occur as initiatives to expand HIV prevention and provide widespread antiretroviral therapy are implemented.

Yet are a lack of supply and inadequate programming the only problems? Surveys indicate that even when people have access to condoms they are still selective about which partnerships to use them in.¹⁰ The low levels of condom use in primary partnerships reflect an important limitation of condoms. In part because of the successes in promotion, the condom is commonly conceptualised as something that is used in less meaningful or more risky sex and is therefore associated with a lack of intimacy and trust. Sex workers report using condoms to distinguish between commercial and non-commercial partners. Practically too, their use may interrupt sex and, for women, require negotiation with their male partner who may resist use. Although female condoms increase women's options, they are costly and their use may still require their partner's consent. Both male and female condoms are unsuitable for couples wanting to conceive. These barriers and evidence on patterns of condom use imply that, with increased investment and programmatic effort, consistent use of condoms may be substantially increased in commercial and casual partnerships and between discordant couples. However, despite our best efforts, consistent use of condoms in primary partnerships is likely to remain difficult to achieve. This key failure of condoms needs to be factored into future prevention planning.

Given the strengths and challenges of achieving high levels of condom use we need to expand both investment in the provision of male and female condoms, and research into alternatives such as the diaphragm and microbicides.^{w1} The experience of family planning has taught us that additional options are likely to increase overall levels of consistent use—the same should be true for prevention of HIV.^{w2} Condoms remain an essential weapon in the fight against HIV, but the armoury needs to be expanded if we are to

enable women in regular partnerships to protect themselves.

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Funding: The review was conducted as part of the Microbicides Advocacy and Networking Project managed by International Family Health with financial assistance from the European Community. The views expressed herein are those of the authors and can therefore in no way be taken to reflect the official opinion of the European Commission or International Family Health.

Competing interests: LH has a dual appointment as a senior programme officer at the Program for Appropriate Technology in Health (PATH) and as a research fellow at the Health Policy Unit of the London School of Hygiene and Tropical Medicine. She serves as director of the Global campaign for Microbicides, an international network of non-governmental organisations working to ensure that as the science of microbicides proceeds, the needs and interests of users, trial communities, and the general public are respected and protected. The campaign has a small staff housed at PATH that provides technical assistance and small grants to partner groups in the developing world. It receives funding from the Ford Foundation, US Agency for International Development, the Moriah Fund, and other foundation donors. It does not accept funding from product sponsors.

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