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Systematic Review of Interventions to Prevent the Spread of Sexually Transmitted Infections, Including HIV, Among Young People in Europe

Aim To examine the effectiveness of interventions seeking to prevent the spread of sexually transmitted infections (STIs), including HIV, among young people in the European Union.

Methods For this systematic review, we examined interventions that aimed at STI risk reduction and health promotion conducted in schools, clinics, and in the community for reported effectiveness (in changing sexual behavior and/or knowledge) between 1995 and 2005. We also reviewed study design and intervention methodology to discover how these factors affected the results, and we compiled a list of characteristics associated with successful and unsuccessful programs. Studies were eligible if they employed a randomized control design or intervention-only design that examined change over time and measured behavioral, biologic, or certain psychosocial outcomes.

Results Of the 19 studies that satisfied our review criteria, 11 reported improvements in the sexual health knowledge and/or attitudes of young people. Ten of the 19 studies aimed to change sexual risk behavior and 3 studies reported a significant reduction in a specific aspect of sexual risk behavior. Two of the interventions that led to behavioral change were peer-led and the other was teacher-led. Only 1 of the 8 randomized controlled trials reported any statistically significant change in sexual behavior, and then only for young females.

Conclusion The young people studied were more accepting of peer-led than teacher-led interventions. Peer-led interventions were also more successful in improving sexual knowledge, though there was no clear difference in their effectiveness in changing behavior. The improvement in sexual health knowledge does not necessarily lead to behavioral change. While knowledge may help improve health-seeking behavior, additional interventions are needed to reduce STIs among young people.

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It is estimated that nearly 1 million people contract a sexually transmitted infection (STI) every day worldwide (1). In Western Europe, 17 million new cases of curable STIs occur annually (2). In the European Union (EU), the most common STIs are chlamydial genital infections, gonorrhoea, hepatitis, and syphilis (3). Addressing more than 30 other bacterial, viral, and parasitic pathogens causing STIs has re-emerged as a major public health issue in Europe, starting in 1999 and building on the 2003 global health sector strategy that focused on HIV/AIDS (4-6). At the 59th World Health Assembly, in May 2006, the World Health Organization approved the Global Strategy for the Prevention and Control of Sexually Transmitted Infections: 2006-2015. This strategy makes strong arguments for why preventing STIs is important not only for maintaining general health, but also for ensuring safe pregnancies and preventing HIV transmission.

STIs are transmitted through sexual contact, including vaginal, oral, and anal sex. Some STIs can also be transmitted through childbirth or breastfeeding, as well as through sharing needles during injecting drug use. Transmission patterns have changed over time and often differ greatly among and within EU member states. In some settings, HIV coinfection with other STIs is common, while in others, they appear independently.

In Europe, the populations most at risk for HIV and for other STIs are often – but not always – the same: men who have sex with men (MSM), injecting drug users and their sexual partners, and heterosexual migrants from outside of the EU. Some STIs, like *Chlamydia*, are more prevalent among young people (7), and interventions frequently target this group to prevent the spread of STIs, both in and out of school. Various theories, including the health belief model, the theory of reasoned action, the trans-theoretical model and social cognitive theory, have been employed to promote behavior change (8). They are utilized in various ways in concrete interventions to reach young people and reduce their risk of contracting STIs. Unfortunately, the lack of age-disaggregated data on sexual and reproductive health and varying definitions of “young” make it difficult to assess the situation and provide a common evidence base for designing these interventions (9).

Inspired by an EU call to action (10), we undertook this systematic review to examine the effectiveness of STI interventions for young people in the EU in the decade after the International Conference on Population and Development, held in Cairo in 1994, which put a focus on them. In

doing so, it gathers a variety of approaches, such as the major implementation models – being peer-, teacher- and health professional-led – for reaching young people with sexual and reproductive health information and services, to inform and advance future policy development.

METHODS

Selection criteria

We designed a highly sensitive search string of over 150 terms based on Medical Subject Headings to capture all articles pertaining to all STIs and their prevention, treatment, epidemiology, and care among young people (aged 10-24) published from 1995 to November 2005. We included studies that took place in 27 selected countries (the 25 EU members in 2005 plus Norway and Bulgaria) and published in any language. We considered all the peer-reviewed studies in 5 databases – MEDLINE, EMBASE, CINAHL, PsychInfo, and POPLINE – and found 15 892 published articles.

Next, we stratified the articles by country. The number of studies available varied from 9 for Cyprus to 2737 for the United Kingdom (UK). We sifted through all the articles individually to filter out articles and studies that were irrelevant or failed to satisfy our inclusion criteria, eg, duplications and studies that did not examine any STIs and study populations in our 27 focus countries. We also excluded contraceptive studies that did not address STIs and studies that addressed HIV and injecting drug use or knowledge but not condom use. We did, however, include relevant-conference proceedings.

Where possible, we used abstracts or short article descriptions to determine relevance. Otherwise, we used the keywords in our original search string. The filtering process left 4875 published articles. We performed a second search on this group with the keywords *intervention**, *promotion**, or *education**, using abstracts or, when they were unavailable, the article titles. We excluded simple assessments of STI knowledge, attitudes, and practice (KAP), or STI KAP plus behavior, which did not reflect the impact of a specific intervention, and ended up with 88 studies.

Finally, we searched these articles with the keywords *random** and *trial** or *random** and *control**. This search resulted in 20 published studies, 18 of which were randomized controlled trials (RCT) of behavior risk interventions. Given this relatively small number, we broadened

the search terms to include *evaluation** or *assessment**, which returned 40 articles written in English, Spanish, French, Italian, and Polish, including the 18 RCTs.

We then employed a snowball technique in when reviewing the RCTs to ensure that the search strings had captured all relevant RCT studies on STI prevention and intervention among young people in the region. After a second hand-review, we eliminated 21 of the 40 studies since they were duplications or failed to fit our original search criteria (eg, addressing young people). This review focuses on the 19 studies, including 8 RCTs that survived the final review. These 19 studies were all published in English, except for one that was in Spanish.

Searched outcomes

We modeled this study on a similar review of adolescent STI interventions in the United States between 1994 and 2004 (11). Our definition of “young people” (10-24 years), employed by the United Nations and the International Planned Parenthood Federation, differs somewhat from the American study definition of “adolescent” (11-22 years) (11). We also included university students in our review, whereas the other review excluded them.

While we included knowledge assessments in our review, we were particularly interested in behavioral change. The possible (and overlapping) behavioral changes included:

- changes in condom use
- reduced/increased frequency of unprotected sexual intercourse
- reduced/increased number of sexual partners
- delayed/accelerated initiation of intercourse
- taking STI tests and/or using STI services.

Additionally, we were interested in identifying the characteristics of successful intervention programs, such as:

- setting (school, clinic, or other)
- nature of study sample
- study design and theoretical framework
- control group
- program implementation (whether led by teacher, peer or health professional)
- intervention content
 - duration of intervention
 - existence of follow-up.

Sexual health intervention studies vary greatly in terms of study design to the interventions investigated and the outcomes examined. While this systematic review focused on behavior change among young Europeans, we regarded a quantitative meta-analysis as inappropriate, choosing instead to combine the studies descriptively based upon the above categories of setting and program implementation.

RESULTS

We found 19 studies of interventions for preventing STIs (including HIV) among young people in Europe (Table 1 and [web extra material table](#)). The studies covered 7 European countries. Nine of the studies (numbers correspond to those in Table 1) were from the United Kingdom (2,3,8,11,12,14,16,17,19). Three of the studies were from Italy (4,5,7), 2 from the Netherlands (10,13), and 2 from Spain (6,15). The other studies were from Bulgaria (1), Estonia (9), and Sweden (18). Eight of the studies were RCTs (4,5,8,10,14,16,17,19).

Ten of the 19 reviewed studies (1,4,6,8,11,12,14,17-19) aimed to measure actual behavior change (eg, using condoms or using STI services for testing). Two studies (3,9) did not measure any changes mainly due to the study design. The other studies, partly overlapping, aimed to detect, eg, change in knowledge and/or intentions as well as behavior change.

One parameter we examined was how who (which type of implementer) leads an intervention affects its effectiveness. We divided the interventions by their implementers. Three interventions (4,9,13) fit in 2 implementer categories:

1. teachers (4-6,9,15,19)
2. peers (1,4,9,10,13,16-18)
3. health professionals (3,7,8,11-14)
4. others (specially trained “sessional” workers) (2).

The intervention settings varied as well: 13 were school based (2,4-7,9,11,12,15-19), 2 were clinic based (8,14), and 6 were community based (1,3,9-11,13). Two school-based interventions (9,11) were also community based.

The intervention target groups were:

- secondary school students (and their teachers) (2,4-7,9,12,15-17,19)
- post-secondary school students (11,18);
- genitourinary medicine clinic patients (8,14)

- male migrants (10,13)
- army recruits (9)
- men who have sex with men (1)
- playground users (3).

Table 1. Key studies of sexually transmitted infections interventions among young people in Europe, 1995-2005

Authors	Setting and study sample	Study design	Comparison group	Program implementers
1. Amirkhani et al, 2003 (12)	Sofia, Bulgaria St Petersburg, Russia Intact social networks of young men having sex with men (MSM): a. 6 in Sofia (n=34) b. 8 in St Petersburg (n=48) Mean age 24.4; 42% in school	Pre- and post-intervention risk assessment, ethnographic observations, sociometric measures, statistical analysis- Community-based outreach	No	Peers (trained social leaders of young MSM networks)
2. Bagnall and Lockerbie, 1996 (13)	Lothian region, Scotland 16- and 17-y-old boys and girls in 8 schools Study: n=747 Follow-up: n=528	Pre- and post-intervention evaluation School based	No	Specially trained sessional workers (young adults from outside)
3. Baraitser et al, 2002 (14)	South London, UKA Adventure playground for boys and girls n=not defined (about 70 discussions) Chiefly aged 13-16	Qualitative approach Community-based outreach	No	Health professional (sexual health outreach nurse)
4. Borgia et al, 2005 (15)	Rome, Italy 18 high schools, students attending last two years n=1295 male and female Age 16-23, median 18	Randomized controlled trial (RCT) Social learning theory School based	Schools were randomly assigned to a peer- or teacher-led program	54 peers (trained by psychologists) 27 teachers (trained by health care workers)
5. Borgia et al, 1997 (16)	Lazio region, Italy 46 junior and senior high schools 3866 students (male and female) Intervention n=2165 Control n=1701 Median age: 15	RCT School based	Schools were randomly divided into treatment and control groups	Teachers (trained by health workers)
6. Diez et al, 2000 (17)	Barcelona, Spain 17 secondary schools (academic or vocational) n=1215 (male and female) Age 15-17	Quasi-experimental study, pre- and post-intervention questionnaires Health belief model; social cognitive theory; theory of planned behavior School based	Intervention group: n=220 students Information group: n=593 Control group: n=402	Teachers (one training session)
7. Donati et al, 2000 (18)	Rome, Italy 5 public secondary schools n=376 (male and female) Age 14-21	5 workshops 3 questionnaires School based	No	Health specialists (1 gynecologist, 1 psychologist)
8. James et al, 1998 (19)	Nottingham, UK Genitourinary medicine clinic patients n=492 (male and female) Age 16+	RCT Social learning theory Clinic based	Intervention (individual counseling and skills training): n=148 Control (written materials only): n=162 Control (usual clinic procedure): n=182	Health advisors (trained)
9. Kaldmäe et al, 2000 (20)	Estonia a. 163 pupils, 53 teachers b. 838 (male and female) pupils, 126 teachers or university students (student teachers) c. 600 men in Estonian Defense Forces, average age 19	Background study Interactive learning methods 2 school based projects 1 community-based outreach project	No	Teachers and peer educators
10. Kocken et al, 2001 (21)	Four largest cities in the Netherlands Turkish and Moroccan migrant men in eg, coffee houses, mosques and bars n=589, groups averaged 23 men Majority <30 years old	RCT Community-based outreach	Intervention group: n=293 Control group: n=296	Peer educators (men from same ethnic group as participants)

11. Low et al, 2003 (22)	Inner London, UK Further education colleges n = 181 (male and female) 39% "black Africans" 43% "black Caribbeans" or "black other" Age 16	Pilot study evaluation Statistical analysis School and community-based	No	Sexual health advisor (qualified nurse), with assistance from project manager
12. Magnusson et al, 2004 (23)	Hertfordshire, UK Four mixed-sex schools n = 589, follow-up n = 512 83% "white" Age 13-14	Pilot non-randomized intervention study Pre- and post-intervention questionnaire, evaluation questionnaire School based	Intervention groups (given information at): a. family planning clinic, b. general practice, c. school drop-in clinic Control: usual school-based sex education	Health professionals (either family planner, general practitioner or a school nurse)
13. Martijn et al, 2004 (24)	Rotterdam, the Netherlands Refugee center a. 75 new male and female migrants (Turkish, Moroccan, other Arabic); two thirds age 18-25 b. 36 Iraqi refugee men; two thirds age 20-30	Comparative study Theory of planned behavior Community-based outreach	a. no b. refugees were assigned to groups led by either a lay health advisor (LHA) or professional health advisor (PHA)	a. 4 trained LHAs b. 2 trained LHAs, 2 PHAs (public health nurses)
14. Oakeshott et al, 2000 (25)	South London, UK 28 general practices n = 1382 women Age 16-34	RCT (cluster randomized trial) Clinic based	Intervention group: 14 general practices Control group: 14 practices	Health professionals (nurses and general practitioners)
15. Rebull et al, 2003 (26)	Southern Tarragona, Spain 12 secondary schools (male and female) n = 896 in pre-test, n = 805 in post-test Age 14-17	Pre- and post-intervention study School based	No	Teachers
16. Stephenson et al, 1998 (27)	Greater London, UK 4 schools n = 469 (male and female) Age 13-14	RCT School based	2 intervention schools (peer-led sex education) 2 control schools (usual teacher-led sex education)	Peers (trained by experts)
17. Stephenson et al, 2004 (28)	Central and Southern England, UK 29 schools n = 8000 (male and female) Age 13-14 (at baseline)	RCT School based	15 intervention schools (peer-led sex education) 14 control schools (usual teacher-led sex education)	Peers (trained by external team)
18. Tydén et al, 1998 (29)	Uppsala, Sweden 2 Swedish universities n = 1600 (male and female) Age 25 and younger	Quasi-experimental study, mass media campaign, peer education School based	Intervention group: n = 600 Control group (no campaign): n = 400 Control group (post-intervention questionnaire only): n = 600	19 trained peer educators (first-year medicine and nursing students)
19. Wight et al, 2002 (30)	Scotland, UK 25 secondary schools n = 8430 (male and female) Age 13-15	RCT (cluster randomized trial) School based	13 intervention schools: Sexual Health and Relationships Program 12 control schools: existing sex education	Teachers

Teacher interventions

Four studies were led just by teachers (5,6,15,19) and 2 by teachers and peers (4,9), all in school. Only 1 of the 6 teacher interventions showed improvements in sexual behavior (6). This intervention was conducted in Spanish secondary schools, involving 1215 students in the 10th and 11th grades. The study reported significant, slightly improved condom use only in the intervention group (baseline 22% vs follow-up 26%, $P < 0.05$, odds ratio, 1.51), associated with those who had their sexual debut after the intervention. Students who were sexually active at the baseline measurement did not change their condom use. The other 5 studies reported no significant behavioral improvements, though knowledge improved in all but Study 9.

Peer interventions

In peer-led interventions, peers (or “lay health advisors”) are trained to implement the intervention in a group they themselves belong to, for example an older student advising younger students.

Five of the 8 peer interventions were school based (4,9,16-18) and 4 community based (1,9,10,13), with Study 9 being both.

Three of the peer-led studies reported that the young people accepted the interventions (1,16,17) – including the only 2 peer studies (1,17) that reported some behavioral improvement. Six of the 8 peer interventions (1,4,10,13,17,18) improved young people’s sexual knowledge and attitudes.

One peer study showing behavior change was conducted in Bulgaria and Russia using 14 social networks of 77 young MSM (1). Before the intervention, 22% of the participants reported using condoms consistently with their main partner, which improved to 45% after the intervention. Condom use with casual partners improved as well (50% at baseline vs 62% at follow-up, $P = 0.04$). In addition, the percentage of participants who reported buying condoms and having them available when needed increased (70% vs 92%, $P = 0.001$).

The other effective peer intervention targeted 8000 English 9th-graders (17). Twenty-nine schools were randomized to either peer-led sex education (intervention) or to continue their usual teacher-led sex education (control). By age 16, significantly fewer girls reported intercourse in the interven-

tion group (34.7% intervention vs 40.8% control, $P < 0.001$), though the boys reported no difference. The proportions of pupils reporting unprotected first sex did not differ between the intervention and control groups for either sex. Of the 4 peer-intervention RCTs (5,10,15,17), this study was the only one reporting any improvement in sexual behavior.

Health professional interventions

Health professionals include general practitioners, gynecologists, psychologists, and school nurses. Six interventions (3,7,8,11,12,14) were led by health professionals, while a seventh was led by both health professionals and peers (13). Three of the health professional-led interventions were school based (7,11,12), and 2 were clinic based, both RCTs (8,14). The other interventions were community based (3,11,13). Young people reported preferring peer and health professional interventions to teacher interventions. However, none of the 7 health professional interventions were effective in changing young people’s sexual behavior, and 2 improved only knowledge and attitudes (7,13).

Interventions implemented by others

One school-based intervention was led by “specially trained sessional workers” (2) – young adults including some living with HIV from outside the school. The study reported no significant improvements in knowledge or behavior.

School-based interventions

Thirteen of the interventions we examined were school based (2,4-7,9,11,12,15-19). Only two of them (6,17) reported improving sexual behaviors, while 8 reported significant improved sexual knowledge or attitudes (4-7,15,17-19).

Clinic-based interventions

Neither clinic-based intervention (8,14) improved sexual knowledge, attitudes, or behavior.

Community-based interventions

The 6 community-based interventions targeted specific subpopulations of young people, including MSM (1), playground users (3), army recruits (9), migrants (10,13), and ethnic minorities (11). Studies 9 and 11 were also school based. We did not include the studies that focused only on general school or clinic populations. In this category

The 6 community interventions included some that were led by peers (1,9,10,13), some by health professionals (3,11,13), with some overlap. Three community interventions showed significant improvements in sexual knowledge and attitudes (1,10,13), but only one positively affected sexual behavior (1).

DISCUSSION

In this systematic review, we investigated the effectiveness of STI interventions for young people in the EU, and in particular which factors are common to interventions that successfully change sexual risk behavior among young Europeans. We analyzed who led the interventions, where they were conducted, what methods and theories they used, how long they lasted and what they achieved.

Most of the 19 STI prevention intervention studies we found targeting young people in Europe were conducted in schools, though others were carried out in clinics and community settings (outreach interventions). They were implemented chiefly by teachers, peers, and health professionals. All of the studies sought to change sexual knowledge and attitudes and/or risk behavior. While 11 of the 19 reviewed studies reported improvements in the sexual knowledge and attitudes of the participants, only 3 of the 10 studies that looked particularly at behavior change reported any significant improvements in sexual behavior (1,6,17).

These 3 studies were heterogeneous in design and outcomes. The intervention in the study conducted by Amirkhani et al (1) was community-based and peer-led, conducted among social networks of young MSM. Leaders of social networks were trained to carry out HIV prevention discussions with network members. The study reported increased condom use and level of AIDS risk reduction knowledge. In addition, the number of participants who reported buying condoms and having them available increased. The intervention in the study by Diez et al (6) was a school based, teacher-led AIDS prevention program, targeting 10th and 11th grade students. It used small group discussions, homework, role-playing, video tapes, and general discussions. This quasi-experimental study, based on health theories, reported increased condom use among those who debuted sexually after the intervention. Finally, the study by Stephenson et al (17) was an RCT of a school-based, peer-led sex education intervention targeting 9th graders. Participatory learning methods and activities were used. After the intervention, fewer girls reported intercourse by age 16, though boys reported no difference. These three interven-

tions were also conducted in different countries (respectively Bulgaria, Spain, and the United Kingdom [England]).

Most of the peer-led interventions (1,4,10,13,17,18) and teacher-led interventions (4-6,15,19) improved participants' sexual knowledge and/or attitudes. Nevertheless, the behavioral changes observed were limited in the 19 interventions we reviewed. The variation in study setting, design, duration, and time invested in leader training was high, but these factors were reported to play no significant role in intervention effectiveness. The interventions lasted from a single 10-minute session (14) to 20-hour-long sessions over two years (19). Leader training ranged from 3-hour-long sessions (17) to 5 weekly sessions of 3-4 hours (1) and 12 meetings over two months (13), though it was often not clearly documented.

Only 2 of the 13 school-based interventions (6,17) reported having any positive effect on behavior. Young people preferred interventions led by peers and health professionals to those led by teachers, yet only 2 peer-led and no health professional-led interventions resulted in significant behavioral change.

A previous American review of school-based programs' effectiveness in reducing sexual risk behaviors (31) found that 4 of 23 (17.4%) interventions clearly improved behavior. These successful interventions shared a narrow focus, the use of social learning theories, experimental activities to convey information, instruction on social influences and pressure on sexual behavior, reinforcing individual values and group norms against unprotected sex, and modeling and practice in communication and negotiation skills.

Intriguingly, the recent review of 39 adolescent STI interventions in the United States by Sales et al (11) shows significantly different results. Three quarters of the school-based studies, two thirds of the clinic-based interventions, the majority of the special population interventions, and all of the community-based interventions in that review reported behavioral changes. The review associated successful interventions with using theory, tailoring to particular subgroups and emphasizing the psychological correlates of risk. Moreover, some teacher-led interventions successfully reduced risk behaviors.

Why the interventions were largely ineffective

Most of the prevention interventions we reviewed were not successful in changing sexual risk behavior. Why are

so many sexual health interventions in Europe ineffective? What was missed or misunderstood in designing them?

One problem in finding evidence-based answers to these questions relates to study design. Methodologically sound studies of prevention interventions among young people are difficult to find: of the hundreds of studies we identified, only 19 were suitable for this review. Although these 19 studies were all published in peer-reviewed journals, they did not all appear to be well designed, which may have contributed to the lack of significant results. On the other hand, since we reviewed only published studies, our conclusions may be biased toward effective interventions (32).

There were other possible sources of bias too. According to Graham (33), outcomes from observational studies are likelier to be positive and biased than RCTs, which are often considered the gold standard in study design. Only one of the 8 RCTs we reviewed (17) reported significant behavioral change – and only for girls. This low success ratio could be interpreted as evidence that sexual health interventions targeting young people in Europe are not working. McQueen and Jones (34) have also suggested that RCTs have only limited relevance in evaluating health promotion interventions.

As change was the expected outcome of the interventions, it is critical to know if any new knowledge or behavioral change is long term. Most of the studies had relatively short follow-ups (time from baseline), although behavior change can take longer to occur. Two studies had no follow-up (3,11), 2 had it immediately after the intervention (9,18), and the others between 4 weeks and 6 months later. Only 3 studies had second follow-ups, 2 after 18 months (8,17), and 1 after 2 years (19). Of the 3 behavior-changing studies, 2 had a single follow-up after about 4 months (1,6) and the other after 6 and 18 months (17). While longer follow-up periods may provide better evidence on an intervention's success, they often remain unrealistic. Moreover, it is difficult to assess the long-term effects of the social and media environment on sexual behavior (19,30).

Many socioeconomic factors affect interventions' success. Most studies in our review were designed for large groups of young people and not for subgroups (eg, boys or migrants). Yet among these large groups, needs, interests, and background knowledge differ greatly; young Europeans are not homogeneous. Sexual intervention programs should accordingly be both age- and experience-ap-

propriate (31). In the review by Sales et al (11), the interventions that decreased high-risk sexual behavior most successfully were tailored to a particular subgroup of adolescents. In some of the studies we reviewed, participants also expressed a preference for confronting sexual issues in same-sex rather than mixed sessions, another factor to consider in designing interventions.

Of course, gender is a critical factor in STI vulnerability. The high prevalence of HIV among MSM and IDUs (who are mostly male) means that men run a higher risk for HIV than women. On the other hand, young women are biologically more vulnerable to STIs, and socially they are often less able to negotiate condom use (35). Interestingly, we did not find any studies of STI interventions in Europe that targeted young prisoners, sex workers, or IDUs. To reach "at-risk" groups, which often have the highest STI rates, interventions should occur outside school more often.

Nevertheless, school-based interventions remain popular, partly because they provide the easiest way to reach large groups of young people. School interventions' effectiveness is influenced by pupils' motivation, teacher attitudes and skills, institutional funding and curricula, and parental support. Critically, school sex education is not universally accepted, as a major European review recently demonstrated (36). The problem is greatest in predominantly Catholic countries, where there is also often resistance to publicly providing sexual health services too. Further, some European Islamic groups similarly oppose comprehensive sexuality education.

Most of the studies we reviewed sought to measure changes in knowledge and attitudes to assess intervention effectiveness. Yet the assumption that changes in sexual knowledge and attitudes automatically affect young peoples' behavior should be questioned. Unfortunately, just 10 of the interventions we reviewed tried to measure actual behavioral change, and most of those that did were unsuccessful, the evidence for behavior change being weak or absent. The results permit us to make no conclusions about the ideal design or implementation of a successful sexual health intervention.

Comparison of our reviewed studies with the studies of Sales et al (11) reveals that many more successful studies from his review were conducted after 1999; this marks the paradigm change from information, education, communication (IEC) to behavior change communication (BCC), whereas most of the studies we reviewed

were still IEC and knowledge/attitudes focused and therefore could not achieve behavior change. It is interesting that the majority of the European studies were still not BCC oriented up to 2004, indicating that the necessary programmatic shift had not happened or happened much later than in the United States.

To control the spread of STIs among young people, we urgently need innovative ideas and well-designed, evidence-based programs. And it should be noted that Stephenson et al (28) found that nearly half of young people learn most about sex outside of school. Existing health intervention theories could be developed further to create such tools. For example, condom use and STI testing have to make sense and personally benefit young people if they are going to use them, as well as being available and affordable – as the health belief model and theory of reasoned action suggest. The trans-theoretical model could also be used to understand better how to change public opinion and get sexual health messages through to young people, for example by using celebrity spokespeople (37). In the review by Sales et al (11), social learning theory and social cognitive theory were the most consistently used frameworks in successful adolescent interventions.

The Sexual Awareness for Europe Project has perhaps the best concise description of how to design STI interventions for young people: “To be effective, STI and HIV prevention for young people should be widely accessible, evidence-based, grounded in human rights, age-specific, and gender responsive, linked with treatment and care and should help build life skills to enable young people to reduce their vulnerability (35).”

It follows that it is also important for young people, including those living with HIV, to help develop and implement STI prevention, treatment and care policies, and programs for young people (35).

Rethinking condom-based programs

Outside the United States, there is very little discussion about any preference for abstinence-based programs over condom-promotion programs. Recent evidence from a systematic review (38) shows that abstinence-only approaches have no effect on HIV risk in high-income countries. Abstinence-plus approaches promote sexual abstinence while encouraging safer-sex strategies, including condom use, for sexually active participants. Another systematic review from the same authors (39) shows

that among youth, abstinence-plus interventions do not affect self-reported STI incidence but appear to reduce short- and long-term HIV risk behavior.

A debate between Steiner and Cates (40) and Genuis (41) about the rising rates of non-HIV STIs illustrates the problems with condom-based interventions. According to Steiner and Cates, well-designed studies show that consistent condom use can reduce the spread of both HIV and other STIs. Other than abstinence, condoms remain the most effective way to control STI transmission. Since condoms do not fully protect against STIs, users should understand their use as safer sex, not safe sex. Condom interventions should focus on ensuring consistent, correct use as well as avoiding and reducing other risks.

Genuis (41) argues for a more comprehensive approach. Since condoms do not prevent skin contact in the external genital area, they provide insufficient protection against some common diseases. Moreover, most young people do not use condoms consistently. Genuis asserts that in actual practice, knowledge, education, and risk awareness do not result in safer sex behavior. Furthermore, he claims that condom-based interventions do not address young people's social and emotional needs, which are linked to high-risk sexual behavior.

Yet the core problem of STI transmission remains: abstinence is difficult to achieve and condoms are often used inconsistently. In particular, they are frequently used incorrectly under the influence of alcohol or other drugs, they can be too inconvenient or expensive to obtain, and some people regard them as “uncool,” unromantic, or simply unpleasant.

A multilevel analysis of information from 15-year-olds in 18 European countries/regions has shown that condom use varies greatly among young people within and between countries. Gender, alcohol, national religion, and income variables were all correlated with individuals' decisions or ability to use a condom (42).

In conclusion, this review found that interventions to prevent the spread of HIV and other STIs among young Europeans can improve sexual health and STI prevention knowledge and attitudes, but their influence on actual sexual behavior remains limited. None of the major implementation models clearly reduced sexual risk behavior, though studies of one teacher-led and two peer-led interventions reported some statistically significant behavioral

improvement. The other 16 studies we reviewed reported no significant behavior changes.

To control the spread of STIs among young people in Europe, prevention interventions should target specific populations and particular sub-groups, including high-risk, hard-to-reach, and out-of-school groups (migrants, school dropouts, IDUs, MSM, and male and female sex workers). Instead of just improving knowledge about sexual health, they should seek to change behavior; the use of theory in this context seems to be ignored. Other promising approaches include enlisting the family as behavioral change agents, broadening the sex education curriculum in schools beyond STI education to psychological reasons for risk taking, implementing interventions in same-sex groups, developing young person-friendly sexual health services, offering anonymous testing (eg, in pharmacies or through the post), and providing free condoms. The risk behavior most susceptible for change is condom use, so focusing on condom use and measuring program effectiveness by testing for sexually transmitted infections would hopefully improve interventions against the spread of HIV and STIs among young people in Europe.

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