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Condom use errors and problems: a global view

Stephanie A. Sanders[A,B,C,H], *William L. Yarber*[A,C,D], *Erin L. Kaufman*[E], *Richard A. Crosby*[A,C,E], *Cynthia A. Graham*[A,C,F] *and Robin R. Milhausen*[A,C,G]

[A]The Kinsey Institute for Research in Sex, Gender, and Reproduction, Indiana University, Bloomington, IN 47405, USA.
[B]Department of Gender Studies, Indiana University, Bloomington, IN 47405, USA.
[C]Rural Center for AIDS/STD Prevention, Indiana University, Bloomington, IN 47405, USA.
[D]Department of Applied Health Science, Indiana University, Bloomington, IN 47405, USA.
[E]College of Public Health at the University of Kentucky University, Lexington, KY 40506, USA.
[F]Department of Psychology, University of Southampton, Southampton SO17 1BJ, UK.
[G]Department of Family Relations and Applied Nutrition at the University of Guelph, Ontario N1G2W1, Canada.
[H]Corresponding author. Email: sanders@indiana.edu

Abstract. ***Background*:** Significantly more research attention has been devoted to the consistency of condom use, with far fewer studies investigating condom use errors and problems. The purpose of this review was to present the frequency of various condom use errors and problems reported worldwide. ***Methods*:** A systematic literature search was conducted for peer-reviewed articles, published in English-language journals between 1995 and 2011. ***Results*:** Fifty articles representing 14 countries met criteria for inclusion. The most common errors included not using condoms throughout sex, not leaving space at the tip, not squeezing air from the tip, putting the condom on upside down, not using water-based lubricants and incorrect withdrawal. Frequent problems included breakage, slippage, leakage, condom-associated erection problems, and difficulties with fit and feel. Prevalence estimates showed great variation across studies. Prevalence varied as a function of the population studied and the period assessed. ***Conclusion*:** Condom use errors and problems are common worldwide, occurring across a wide spectrum of populations. Although breakage and slippage were most commonly investigated, the prevalence of other condom use errors and problems found in this review were substantially higher. As a framework for understanding the role of condom errors and problems in inadequate protection, we put forward a new model: the Condom Use Experience model. This model can be used to generate testable hypotheses for future research. Addressing condom use errors and problems in research and interventions is crucial to closing the gap between the perfect use and typical use of condoms.

Additional keywords: condom breakage, condom slippage, sexual behaviour, sexually transmissible infections.

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Introduction

The global pandemic of HIV, sexually transmissible infections (STIs) and unintended pregnancy necessitates an accelerated emphasis on correct and consistent male condom use. According to global health organisations, 'The male latex condom is the single, most efficient, available technology to reduce the sexual transmission of HIV and other sexually transmitted infections.'[1] However, condom effectiveness is compromised by user errors and lack of use.[2] For example, the World Health Organisation reported that condoms have a 2% perfect use failure rate for pregnancy, but the typical failure rate is 15%.[3,4] Magnified over the world population, this 4-fold difference has substantial implications for population growth and, in turn, public health. The gap between perfect and typical use has similar relevance for HIV and STI prevention, suggesting that millions of infections could be avoided by improved user effectiveness. The discrepancy between perfect and typical failure rates is attributable to the combination of both inconsistent and incorrect use, but the respective contribution of user errors to typical use failure rates has never been quantified.[5]

Significantly more attention has been given to consistency of condom use, with far fewer investigations on the details of user errors and problems. From a methodology perspective, measuring condom use frequency is a relatively straightforward process.[6] Unfortunately, the same cannot be said about measuring the numerous errors and problems that individuals may experience when using condoms. Nonetheless, a growing body of literature is documenting the many different condom

errors and problems, and their relative prevalence and correlates. We use the term errors to refer to those behaviours that represent incorrect use of condoms (e.g. letting condoms contact sharp objects or other application errors, not using condoms through the entire act of intercourse). Problems refer to those experiences that may be under less direct behavioural control of the condom user, but may compromise condom use or condom protection (e.g. breakage, slippage, erection problems, problems with fit and feel). Failing to account for condom use errors and problems can lead to faulty conclusions regarding condom effectiveness or evaluation of interventions. Additionally, errors and problems may not only compromise condom efficacy, but may also discourage condom use if people become frustrated or have less pleasurable experiences as result of them. Accordingly, the purpose of this review was to present the frequency of various condom use errors and problems reported worldwide. Although the literature is sparse, it is nonetheless important because it can inform efforts to promote effective condom use worldwide.

Methods

We considered all English-language publications from 1995 to the present that were published in peer-reviewed journals available through the university library systems. In March–May 2011, we queried the PubMed Database using the following search terms: condom rate, condom error rate, condom problem rate, condom errors, condom problems, condom failure, condom failure rates, condom failure prevalence, condom failure international, incomplete use, oil-based lubricant condom failure, oil lubrication condom failure, lubrication condom, lubrication male condom, lubrication condom, oil lubrication, oil male condom, and condom with fit or feel. Article information was then extracted and entered into tables, with the principal summary measure being the prevalence of the condom use problem/error in the study population. Although different wording was used across studies, we classified errors as follows:

- Incomplete use – not using a condom during the entire act of intercourse, including late application and early removal. Late application is when intercourse begins before condom application. Early removal refers to taking the condom off followed by unprotected intercourse (Table 1).
- Other condom use errors – including (1) completely unrolling the condom before putting it on, (2) not leaving space at the tip of the condom, (3) not squeezing air from the tip before use, (4) putting the condom on inside out and then flipping it over to use, (5) starting sex before the condom was unrolled to the base of the penis, (6) damage issues (using a sharp object to open the package, letting the condom contact a sharp object, knowingly using a damaged condom, not checking for physical damage), (7) lubrication issues (condom not lubricated, using oil-based lubricant), (8) incorrect withdrawal or not holding base of condom during withdrawal, (9) reuse of a condom (during same sexual encounter) and (10) storage and expiration date issues (Table 2).
- Problems related to breakage, slippage, leakage or 'condom failure' (Table 3).
- Problems with condom-associated erection problems (either during application or during intercourse while using a condom) and problems with the 'fit' or 'feel' of condoms, including problems related to the size or shape of the condom, or discomfort or interference with sensation (Table 4).

Results

Fifty articles representing 14 countries met the criteria for inclusion. All studies reviewed below reported findings for condom use for either vaginal or anal intercourse or both. Broadly, two types of prevalence estimates are reported: (1) proportion of individuals reporting an error or problem within a specified recall period; or (2) proportion of events for which an error or problem occurred. The populations studied are noted in the tables, as are the recall periods (in the footnotes) which varied across studies. Given the numbers of studies found in each category, we present the findings in four tables, two for errors and two for problems.

Incomplete use

Table 1 displays findings from 14 studies assessing incomplete use. In some studies, the type of incomplete use was not specified or the errors were combined in reporting;[7–9] in some, the terms sex or sexual activity were used without specifying intercourse. Six studies reported the prevalence of late application among participants, with 17.0% to 51.1% of participants reporting this error.[10–16] Seven studies reported the prevalence of late application as a proportion of condom use events, with estimates ranging from 1.5% to 24.8%.[16–22] Six studies reported early removal at the participant level, with prevalence ranging from 13.6% to 44.7%.[11,13–15,19,23] Six studies reported early removal at the event level, with prevalence ranging from 1.4% to 26.9%.[16–18,20–22] Finally, two studies reported a combined prevalence (either late application or early removal or both), ranging from 20.0% to 60.0% of participants.[7,8] One study found 2% of respondents reported both late application and early removal for the same event.[18]

Other condom use problems

Table 2 displays the 10 categories of other condom use errors. Two studies estimated the prevalence of completely unrolling the condom before putting it on, reported by 2.1% to 25.3% of participants.[10,13] Three studies reported prevalence rates for not leaving space at the tip, ranging from 24.3% to 45.7% of participants.[10,13,14] One of these studies further reported that 41.6% of men and 48.1% of women reported that air was not squeezed from the tip before use.[10] Four studies reported that between 4.0% and 30.4% of participants had put the condom on inside out and then flipped it over.[10,11,13,14] Two studies reported 8.8% of men and 11.2% of women started sex before the condom was unrolled to the base of the penis.[13,14] Several damage-related issues were reported across five studies. Exposing the condoms to sharp objects was reported by 2.1–11.2% of participants from three studies,[13–15] and for 4.1% and 7.5% of events in two other investigations.[16,20] Not inspecting the condom for damage was reported by 74.5% of men and 82.7% of women in two studies.[13,14] In two studies,

Table 1. Prevalence of incomplete condom use (late application or early removal)

Prevalence	Population	Country	Reference number
Late application			
18.6% of men[A] and17.0% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
43.0% out of 509 study participants[B]	Adolescent care clinic in a large paediatric hospital	USA	11
47.0% out of 2614 men[C] for insertive anal intercourse and 44.1% out of 3699 men[C] for receptive anal intercourse	Anonymous survey of gay and bisexual men	Canada	12
42.8% out of 158 university men[B]	University undergraduate men	USA	13
51.1% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
38.0% out of 221 university undergraduates[B]	University undergraduates	USA	15
1.5% out of 134 events[D]	14- to 18-year-old girls in a detention facility	USA	16
4.3% out of 9898 condom use events[B]	STI clinics as a part of the RESPECT project	USA	17
12.0% out of 6325 condom use events[E]	Men recruited via print and electronic advertisements in seven high HIV or STI areas	USA	18
18.7% out of 278 participants for the last three events[B]	Men attending a public urban STI clinic	USA	19
8.4% out of 834 condom-protected events[B]	Men attending a public urban STI clinic	USA	20
20.4% out of 188 men reporting that condom use was a unilateral decision for last condom use event[B] and 24.8% out of 470 men reporting that condom use was a mutual decision[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	21
22.0% out of 656 men who did not use erection enhancing medications during last condom use event[B] and 20.0% of 49 men who used erection enhancing medications[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada, and British Isles	22
Early removal			
22.0% out of 509 participants reporting vaginal sex[B]	Adolescent care clinic in a large paediatric hospital,	USA	11
15.3% out of 158 participants[B]	University men	USA	13
14.8% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
13.6% out of 221 participants[B]	University undergraduates	USA	15
23.7% out of 190 participants (who did not report breakage) for at least once of the last three events[B]	Urban STI clinic	USA	19
44.7% out of 436 participants[B]	Men responding to an online questionnaire	USA	23
12.7% out of 834 condom-protected events[B]	Men attending a public urban STI clinic	USA	20
26.9% out of 134 events[D]	14- to 18-year-old girls in a detention facility	USA	16
1.4% out out of 9898 condom use events[B]	STI clinics as a part of the RESPECT project	USA	17
3.1% out of 6325 condom use events[E]	Men recruited via print and electronic advertisements in seven high HIV and STI areas	USA	18
12.8% out of 188 men reporting that condom use was a unilateral decision for last condom use event[B] and 5.7% of 470 men reporting that condom use was a mutual decision[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada, and British Isles	21
8.0% out of 656 men who did not use erection enhancing medications during last condom use event[B] and 20.0% of 49 men who used erection enhancing medications[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada, and British Isles	22
Incomplete use (timing unspecified or both)			
60.0% out of 61 participants reporting discomfort[B] and 33.1% out of 133 participants reporting no discomfort[B]	University students	USA	7

Table 1. (*continued*)

Prevalence	Population	Country	Reference number
20.0% out of 150 participants[F]	Men who have sex with men in a sex resort	USA	8
19.5% partial uses (penile–vaginal contact before use or after removal of the condom) or incorrect donning (the tip of the penis touched the outer surface of the condom before it was donned) out of 700 condom uses[A]	Women in a reproductive health outpatient clinic	USA	9
2.0% (both late application and early removal) out of 6325 condom use events[E]	Men recruited via print and electronic advertisements in seven high HIV and STI areas	USA	18

[A]past month; [B]past 3 months; [C]12 months; [D]past 2 months; [E]daily diaries; [F]over 7 months.

knowing use of a damaged condom was reported by 0–0.6% of participants[13,14] and, in another study, during 1.5% of events.[16] Across three studies, using a condom that was not lubricated was reported by 16.0–25.8% of participants.[13–15] Two studies reported 3.2% of women and 4.7% of men used an oil-based lubricant,[13,14] with another reporting that oil-based lubricants were used on 4.1% of events.[20] Incorrect withdrawal was reported by 31.2% of men and 27.1% of women in one study,[10] and in 43.0% and 57.0% of condom use events in two other studies.[9,24] Reusing the condom during the same intercourse session was reported for 1.4–3.3% of participants in three studies[10,13,14] and for 1.5% of events in another study.[16] Incorrect storage was reported by 3.3–19.1% of participants in three studies.[13–15]

Breakage, slippage, leakage or 'condom failure'

Table 3 shows the studies examining breakage, slippage, leakage and 'condom failure' rates. Breakage rates ranged from 0.8% to 40.7% of participants across 15 studies[7,8,10,11,13–15,25–32] and 0.0% to 32.8% of condom use events across 23 studies.[9,16,17,20,21,24,26,32–47] Studies have reported on slippage in a variety of ways, sometimes specifying timing (during intercourse or upon withdrawal) and sometimes specifying degree of slippage (complete or partial); most of the reports, however, did not specify either of these. It is worth noting that slippage during withdrawal may reflect the user error of not holding the rim of the condom during withdrawal. Estimates for slippage during intercourse ranged from 13.1% to 19.3% of participants in three studies[13–15] and from 0.0% to 6.6% for condom use events across five additional studies.[20,22,36,40,42] Estimates for slippage during withdrawal ranged from 11.6% to 14.9% of participants in three studies[13–15] and from 0.0% to 12.8% of events in four other studies.[20,21,36,42] For studies which did not specify timing of slippage, the range of estimates was 0.8%[31] to 36.2%[27] of participants across eight studies.[8,11,26–31] The event level estimates for slippage ranged from a low of 0.0% for a sample of licensed prostitutes in Nevada USA[36] to a high of 78.0% reporting partial slippage of less than 1 inch for baggy condoms used by monogamous couples.[24] Leakage was reported by 7.6% of men[13] and 12.5% of women[14], and for 0.4%[17] to 6.5% of events.[15] Breakage and slippage combined or complete failure was reported by 25.2% to 44.7% of participants in seven studies[14,23,27,48–51] and from 0.7% to 7.6% of events in four studies.[9,45,52,53]

Condom-associated erection problems and problems with 'fit' and 'feel'

Table 4 presents data for condom-associated erection problems, and problems with fit and feel. Erection problems can occur during condom application or during intercourse while using a condom. Condom-associated erection problems during application ranged from 14.3% to 28.1% of participants in four studies,[13–15,54] and 5.3% and 9.4% of events in two others.[20,21] Condom-associated erection problems during intercourse were reported by 9.9% to 20.2% of participants across four studies[13–15,54] and in 6.0% and 20.0% of events in two studies.[20,22] Problems with fit and feel ranged from 7.0% to 29.9% of participants across three studies[54–56] and from 9.0% to 44.7% of events across three studies,[20,22,23] depending on the specific aspect assessed.

Discussion

This review from studies representing 14 countries suggests that condom use errors and problems are common events worldwide. Moreover, the diversity of samples studied (e.g. sex workers, STI clinic attendees, monogamous married couples, college students) suggest that these errors and problems may be affecting millions of people. Common errors include: incomplete use (i.e. late application of condoms after intercourse began, early removal of condom followed by unprotected intercourse), not leaving space at the tip, not squeezing air from the tip before use, putting the condom on inside out and having to flip it over, not using water-based lubricant and incorrect withdrawal. Common problems include: breakage, slippage, leakage, erection problems during condom application, erection problems during intercourse while using a condom, and problems with the fit or feel of condoms.

The largest number of studies were those documenting the prevalence of breakage and slippage (see Table 3). Clearly, these studies are important, given that breakage and slippage are two of the primary forms of condom use failure. However, other errors and problems may be similarly important. First, these errors may expose a partner to infection via skin-to-skin contact with a penis or ejaculate. For example, frequency estimates of early removal of condoms followed by unprotected intercourse

Table 2. Prevalence of other condom use errors

Prevalence	Population	Country	Reference number
Completely unrolling the condom before putting it on			
23.4% of men[A] and 25.3% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
2.1% out of 158 participants[B]	University undergraduate men	USA	13
Not leaving space at tip			
24.3% of men[A] and 30.0% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
40.4% out of 158 participants[B]	University undergraduates	USA	13
45.7% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
29.7% out of 834 condom use events[B]	Men attending a public urban STI clinic	USA	20
Not squeezing air from tip before use			
41.6% of men[A] and 48.1% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
Putting the condom on inside out and then flipping it over to use			
10.6% of men[A] and 7.1% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
4.0% out of 509 participants[B]	Adolescent care clinic in a large paediatric hospital	USA	11
30.4% out of 158 participants[B]	University undergraduate men	USA	13
29.6% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
13.7% out of 834 condom use events[B]	Men attending a public urban STI clinic	USA	20
Starting sex before condom was unrolled to the base of the penis			
8.8% out of 158 participants[B]	University undergraduate men	USA	13
11.2% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
Damage issues			
74.5% out of 158 participants did not check the condom for visible damage;[B] 0.6% knowingly used a damaged condom;[B] 2.1% allowed the condom to contact a sharp object[b]	University undergraduate men	USA	13
82.7% out of 102 participants did not check the condom for visible damage[B] 0% (none) knowingly used a damaged condom[B] 3.4% allowed the condom to contact a sharp object[B]	University women who put condoms on their male partners	USA	14
11.2% out of 223 participants opened condom package with sharp tool;[B] 6.8% out of 222 participants reported that a sharp object contacted the condom after opening[B]	University undergraduates	USA	15
67.4% out of 834 condom events involved not checking for visible damage;[B] in 4.1% of events, the condom contacted a sharp object[B]	Men attending a public urban STI clinic	USA	20
1.5% of out 134 events involved knowingly using a damaged condom;[C] 7.5% out of 134 events involved letting the condom contact sharp jewellery or fingernails[C]	14- to 18-year-old girls in a detention facility	USA	16
Lubrication issues			
19.2% out of 158 participants used a condom without lubricant;[B] 4.7% used an oil-based lubricant[B]	University undergraduate men	USA	13

Table 2. (*continued*)

Prevalence	Population	Country	Reference number
25.8% out of 102 participants used a condom without lubricant;[B] 3.2% used an oil-based lubricant[B]	University women who put condoms on their male partners	USA	14
16.0% out of 225 participants reported condoms not being lubricated[B]	University undergraduates	USA	15
4.1% out of 834 condom-protected events used an oil-based lubricant[B]	Men attending a public urban STI clinic	USA	20
Incorrect withdrawal			
31.2% of men[A] and 27.1% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American,	USA	10
43.0% out of 700 condom uses[A]	Women in a reproductive health outpatient clinic	USA	9
57.0% for baggy condoms *v.* 56.0% for straight condoms out of 500 condoms of each type did not hold base of condom during withdrawal[D]	100 couples recruited at two centres	USA	24
Reused a condom (during the same sexual encounter)			
3.3% of men[A] and 1.9% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
1.4% out of 158 participants[B]	University undergraduate men	USA	13
2.3% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
1.5% out of 134 events[C]	14- to 18-year-old girls in a detention facility,	USA	16
Storage and expiration date issues			
7.9% out of 158 participants used condoms stored in wallet for >1 month;[B] 3.3% did not store condoms in a cool, dry location;[b] 2.0% knowingly used an expired condom;[B] 61.4% did not check the expiration date[B]	University undergraduate men	USA	13
1.7% out of 102 participants did not store the condom in a cool, dry location;[B] 0% (none) knowingly used an expired condom;[B] 71.3% did not check the expiration date[B]	University women who put condoms on their male partners	USA	14
19.1% out of 225 participants used condoms stored in a wallet for >1 month[B]	University undergraduates	USA	15

[A]past month; [B]past 3 months; [C]past 2 months; [D]time not specified.

are often greater than those for breakage and slippage. Thus, this error may represent a more likely threat of exposure than that resulting from breakage or slippage.

Second, based on the findings reported in Table 2, it is probable that breakage and slippage often occur as a result of other errors made by users. Indeed, incorrect methods of applying condoms such as letting the condom contact sharp objects have been correlated with condom breakage,[25,31,57] as have problems with lubrication (e.g. dryness or use of oil-based lubricants).[34] In one study,[13] the more errors a person reported, the greater the odds of breakage, slippage or both. Inadequate condom protection results not only from breakage, slippage and leakage, but also from any condom use error that may lead to these outcomes or to potential exposure to pathogens (risk for STIs) or sperm (risk for unintended pregnancy) in and of itself (e.g. incomplete use). Inadequate condom protection also accrues from inconsistent or non-use of condoms across events. Therefore, much may be gained by a broader examination of errors and problems beyond breakage and slippage in terms of both their prevalence and their relationship to inadequate condom protection.

One error that is obviously problematic in terms of risk of exposure is incomplete use. This error has frequently been investigated, and estimates suggest it is very commonly reported. Despite this, the actual duration of condom use during intercourse is unknown; for example, during late application how much time elapses between penetration and condom application? Regarding early removal of condoms, we know that issues related to arousal and pleasure and erectile difficulties can be the impetus for taking off condoms before sex is over.[19,22,54]

Condom-associated erection difficulties have been surprisingly under-researched. Yet what evidence we have suggests that they may be of crucial importance in terms of their relationship to slippage,[54,57] and possibly to attitudes towards condoms and future use. We also have evidence that

Table 3. Prevalence of breakage, slippage and leakage

Prevalence	Population	Country	Study
Breakage			
40.7% of men[A] and 31.4% of women[A]	548 male and 576 female STI clinic attendees, predominately low-income and African-American	USA	10
31.0% out of 509 study participants[B]	Adolescent care clinic in a large paediatric hospital	USA	11
29.0% out of 158 participants[B]	University undergraduate men	USA	13
19.3% out of 102 participants[B]	University women who put condoms on their male partners	USA	14
14.1% out of 220 participants[B]	University undergraduates	USA	15
7.0% out of 150 participants[C]	Men who have sex with men in a sex resort	USA	8
31.3% out of 278 participants[B]	Men attending a public urban STI clinic	USA	25
3.4% out of 4463 subjects[D]	Subsample of those reporting on last condom use from a large-scale, national random sample telephone survey	France	26
34.0% out of 200 respondents who reported exchanging money for sex[B]	Female sex workers in a medium-sized city	China	27
18.5% out of 314 men[E]	Men who presented with urethral discharge at the largest STI clinic	Jamaica	28
37.1% out of 7391 participants (lifetime)[F] and 23.8% out of 3552 participants (past 12 months)[F] experienced breakage during entry or intercourse; 16.9% out of 3552 men[F] experienced breakage during withdrawal or removal of condom	Men responding to computer-assisted telephone interviews	Australia	29
26.0% (lifetime) and 1.4% (during last month) out of 706 men;[A] 24.0% (lifetime) and 1.2% (during last month) out of 1136 women[A]	Random sample from the Finnish Population Register who were mailed a questionnaire	Finland	30
1.1% out of 130 Mexican men,[G] 0.8% out of 130 Filipino men[G] and 1.6% out of 126 Dominican men[G] experienced complete breakage during intercourse	Family planning clients provided with five condoms	Mexico, Philippines, and Dominican Republic	31
22.8% out of 194 participants,[B] 40.0% out of 61 participants with discomfort[B] and 15.2% out of 133 participants without discomfort[B]	University students	USA	7
16.6% out of 2592 participants[E] and 2.1% of events;[E] 2.5% for receptive anal intercourse[E] and 1.9% for insertive anal intercourse[E]	HIV seronegative men recruited from the HIV Network for Prevention Trials Vaccine Preparedness Study who reported having anal intercourse with a man in the past 6 months	USA	32
1.2% out of 1885 work days[I]	Female brothel-based sex workers	Singapore	33
32.8% out of 134 events[H]	14- to 18–year-old girls in a detention facility	USA	16
2.0% out of 9898 events when a condom was used[B]	STI clinics as a part of the RESPECT project	USA	17
3.2% out of 188 men reporting that condom use was a unilateral decision for last condom use event[B] and 0.8% of 470 men reporting that condom use was a mutual decision[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	21
21.2% out of 264 men reporting on last condom use events[B]	African-American men attending a publically funded STI clinic who exclusively had sex with women	USA	34
15.0% out of 834 condom use events[B]	Men attending a public urban STI clinic	USA	20
1.3% out of 700 condoms[A]	Women in a reproductive health outpatient clinic	USA	9
5.9% out of 440 men during last condom use event[B]	Men recruited online for a questionnaire on condom use and erection enhancing substances	predominantly USA, UK, and Canada	35
0% (none) of 353 condom-protected acts of vaginal intercourse	Licensed prostitutes	USA	36
0.9% out of 3607 events[J]	Men recruited through advertisements	Australia	37

Table 3. (*continued*)

Prevalence	Population	Country	Study
1.0% out of 5010 sex acts with condoms[B]	Commercial female sex workers	Thailand	38
0.4% out of 4637 attempts to use condoms[B]	Monogamous couples	USA	39
1.6% out of 820 standard condoms[J] and 0.7% out of 820 custom fit condoms[J]	Sexually active males who had access to the internet (experimental crossover design)	USA	40
2.3% out of 21 852 condoms[E]	Women attending an STI clinic	USA	41
0.4% out of 3715 condoms[E]	Couples combined from several trials	USA	42
3.1% out of 12 253 male condoms[E]	Women recruited in a health department STI waiting room	USA	43
1.3% out of 3658 events[J]	Men who completed diary sheets when they used supplied condoms	Australia	44
3.4% out of 707 participants for last condom use event[D]	Subsample of those reporting on last condom use from a large-scale, national random sample telephone survey	France	26
2.0% for baggy *v.* 1.0% for straight condoms out of 500 condoms of each type[J]	100 couples recruited at two centres	USA	24
0.6% for the polyurethane condom out of 941 attempts to use the condom[J] and 1.3% for the latex condom out of 960 attempts to use the condom[J]	Monogamous couples in a randomised controlled study	France	45
7.0% for standard tactylon condoms, 6.8% for baggy tactylon condoms, 6.1% for low-modulus tactylon condoms and 3.68% for standard latex condoms out of 428 couples engaging in vaginal use[B]	Monogamous partners in a prospective crossover study	USA	46
0.3% out of 635 male condoms without corrective action[A] and 1.1% out of 635 male condoms with corrective action[A]	Women in a reproductive health outpatient clinic	USA	47
Slippage			
13.1% (during intercourse) out of 158 participants[B] and 13.2% (upon withdrawal)[B]	University undergraduates	USA	13
19.3% (during intercourse) out of 102 participants[B] and 14.9% (upon withdrawal)[B]	University women who put condoms on their male partners	USA	14
14.8% (complete slippage during intercourse) out of 216 participants[B] and 11.6% (upon withdrawal) out of 216 participants[B]	University undergraduates	USA	15
3.5% of 314 men reported complete condom slippage[E]	Men who presented with urethral discharge at the largest STI clinic	Jamaica	28
1.9% out of 130 Mexican men,[G] 1.2% out of 130 Filipino men[G] and 0.8% out of 126 Dominican men[G] experienced complete slippage during intercourse or withdrawal	Family planning clients provided with five condoms	Mexico, Philippines and Dominican Republic	31
15.0% (not specified) out of 509 study participants who reported vaginal sex[B]	Adolescent care clinic in a large paediatric hospital	USA	11
6.0% (not specified) of 150 participants[C]	Men who have sex with men in a sex resort	USA	8
1.1% (not specified) out of 4463 individual	Subsample of those reporting on last condom use from a large-scale, national random sample telephone survey	France	26
36.2% (not specified) of 200 respondents who reported exchanging money for sex[B]	Female sex workers in a medium-sized city	China	27
18.1% (not specified) out of 3552 men[F]	Men recruited through a computer-assisted telephone interviews	Australia	29
15.0% (lifetime) and 1.1% (during last month) out of 706 men and 16.0% (lifetime) and 0.3% (during last month) out of 1136 women	Random sample from the Finnish Population Register aged 18 to 50 years old who were mailed a questionnaire	Finland	30
2.1% (not specified) out of 1885 workdays[I]	Female brothel-based sex workers	Singapore	33
0.4% slippage (during intercourse) out of 3715 condoms,[E] 0.6% (upon withdrawal) out of 3715 condoms[E] and 1.1% (not specified) out of 3715 condoms[E]	Couples combined from several trials	USA	42

Table 3. (*continued*)

Prevalence	Population	Country	Study
3.5% (complete condom slippage) out of 700 condom uses[A]	Women in a reproductive health outpatient clinic	USA	9
6.6% slippage (during intercourse) of 834 condom-protected events[B] and 7.5% slippage (during withdrawal)[B]	Men attending a public urban STI clinic	USA	20
1.9% out of 3607 condoms[J]	Male participants used supplied condoms with and without lubrication; the men were recruited through advertisements	Australia	37
2.1% out of 3658 events[J]	Men who completed diary sheets when they used supplied condoms	Australia	44
1.1% out of 707 participants for last condom use event[D]	Subsample of those reporting on last condom use from a large-scale, national random sample telephone survey	France	26
0% complete slippage, 0.6% complete slippage during withdrawal, 3.4% partial slippage during intercourse and 4.3% partial slippage during withdrawal during 353 condom-protected acts of vaginal intercourse	Licensed prostitutes	USA	36
12.8% during withdrawal for 188 men reporting that condom use was a unilateral decision for last condom use event[B] and 6.4% for 470 men reporting that condom use was a mutual decision[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	21
3.0% slippage during sex for 656 men who did not use erection enhancing medications for last condom use event[B] and 15.0% for 49 men who used erection enhancing medications[B]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	22
6.0% for baggy condoms *v.* 5.0% for straight condoms (complete condom slippage) out of 500 condoms of each type[J]	100 couples recruited at two centres	USA	24
1.7% (complete condom slippage) out of 820 standard condoms;[J] 3.1% (complete condom slippage) out of 820 custom fit condoms;[J] 0.4% (partial upon insertion), 0.7% (partial during intercourse) and 1.4% (partial upon withdrawal) out of 820 standard condoms;[J] 0.3% (partial upon insertion), 0.9% (partial during intercourse) and 2.7% (partial upon withdrawal during intercourse) out of 820 custom fit condoms[J]	Sexually active males who had access to the internet	USA	40
0.7% (complete condom slippage) for standard tactylon condoms, 1.3% for baggy tactylon condoms, 0.8% for low-modulus tactylon condoms, 1.1% for standard latex condoms out of 428 couples engaging in vaginal use[B]	Monogamous partners in a prospective crossover study	USA	46
0.8% (complete slippage with corrective action) out of 635 male condoms[A] and 1.6% (complete slippage without corrective action) out of 635 male condoms[A]	Women in a reproductive health outpatient clinic	USA	47
2.7% out of 700 condom uses (partial, $\geq$1 inch)[A] and 2.7% out of 700 condom uses (partial, <1 inch)[A]	Women in a reproductive health outpatient clinic	USA	9
1.1% out of 12 253 male condoms (not specified)[E]	Women recruited in a health department STI waiting room	USA	43
0.6% (not specified) out of 4637 attempts to use condoms[B]	Monogamous couples	USA	39
0.1% (not specified) out of 5010 sex acts with condoms[B]	Commercial female sex workers	Thailand	38
1.3% (not specified) out of 9898 events[F]	STI clinics as a part of the RESPECT project	USA	17
1.3% (not specified) out of 21 852 condoms[E]	Women attending an STI clinic	USA	41

Table 3. (*continued*)

Prevalence	Population	Country	Study
1.1% for the polyurethane condom out of 941 attempts to use the condom *v.* 0.5% for the latex condom out of 960 attempts to use the condom (complete, during intercourse or withdrawal)[J]	Monogamous couples in a randomised controlled study	France	45
10% for baggy *v.* 11% for straight out of 500 condoms of each type (not specified);[J] 16% for baggy *v.* 26% for straight (partial, ≥1 inch)[J] 78% for baggy *v.* 69% for straight (partial, <1 inch)[J]	100 couples recruited at two centres	USA	24
3.0% out of 635 male condoms (partial, with corrective action)[A] 1.1% (partial, without corrective action)[A]	Women in a reproductive health outpatient clinic	USA	47
Leakage issues			
7.6% (ejaculate dripped onto genitals, anus or mouth) out of 158 participants[B]	University undergraduate men	USA	13
12.5% (ejaculate dripped onto genitals, anus or mouth) out of 102 participants[B]	University women who put condoms on their male partners	USA	14
6.5% (ejaculate dripped onto genitals or mouth) out of 214 participants[B]	University undergraduates	USA	15
0.4% out of 9898 condom use events[B]	STI clinics as a part of the RESPECT project	USA	17
Breakage and slippage combined, or condom failure			
28.0% breakage or slippage of 102 participants[B]	University women who put condoms on their male partners	USA	14
44.7% breakage and/or slippage out of 436 participants[B]	Convenience sample of men who completed a questionnaire online	USA	23
48.0% breakage or slippage of 200 respondents who reported exchanging money for sex[B]	Female sex workers in a medium-sized city	China	27
25.2% breakage or slippage out of 290 respondents[J]	Clients of female sex workers in a 'red light district'	Vietnam	48
35.2% breakage or slippage for 443 males during up to three condom use events[B] and 36.0% breakage or slippage for 478 females during up to three condom use events[B]	Adolescents from primary care facilities	USA	49
34.1% (condom failure) out of 481 men[B]	Condom-using males recruited from three cities	USA	50
19.0% (condom failure) out of 1753 condom users[F]	Data taken from the National Survey of Fertility and Contraceptive Practice	Mainland China	51
0.7% condom failure with spermicide and 1.83% without spermicide of 12 530 condoms[E]	Couples recruited from various locations (e.g. family planning clinics and local universities) including primary care sites via media and other publicity	United Kingdom	52
7.6% (complete failure) for standard tactylon condoms, 8.1% for baggy tactylon condoms, 6.86% for low-modulus tactylon condoms, 4.7% for standard latex condoms out of 428 couples engaging in vaginal use;[B] 4.2% (complete clinical failure) for standard ractylon condoms, 4.9% for baggy tactylon condoms,4.9% for low-modulus tactylon condoms, 2.0% for standard latex condoms out of 428 couples engaging in vaginal use[B]	Monogamous partners in a prospective crossover study	USA	46
0.8% (condom failure) out of 700 condom uses[A]	Women in a reproductive health outpatient clinic	USA	9
3.3% (condom failure) out of 929 episodes[F]	Data taken from 2000 Cocon Study	France	53

[A]past month; [B]past 3 months; [C]over 7 months; [D]last sexual encounter; [E]6 months; [F]12 months; [G]past 4 months; [H]past 2 months; [I]1 working day; [J]time not specified; [K]3 weeks.

Table 4. Prevalence of erection loss (during application and during intercourse while using a condom), and problems with fit and feel

Prevalence	Population	Country	Study
Erection issues during application			
19.6% out of 158 participants[A]	University undergraduate men	USA	13
14.3% of 102 participants[A]	University women who put condoms on their male partners	USA	14
15.1% out of 225 participants[A]	University undergraduates	USA	15
28.1% of 278 participants at least once during last three events[A]	Men attending a public urban STI clinic	USA	54
9.4% out of 834 condom-protected events[B]	Men attending a public urban STI clinic	USA	20
9.1% out of 188 men reporting that condom use was a unilateral decision for last condom use event[A] and 5.3% out of 470 men reporting that condom use was a mutual decision[A]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	21
Erection problems during intercourse			
19.6% out of 158 participants[A]	University undergraduate men	USA	13
20.2% out of 102 participants[A]	University women who put condoms on their male partners	USA	14
9.9% out of 222 participants[A]	University undergraduates	USA	15
13.4% of 278 participants at least once during last three events[A]	Men attending a public urban STI clinic	USA	54
14.3% out of 834 condom-protected events[B]	Men attending a public urban STI clinic	USA	20
6.0% out of 656 participants who did not use erection enhancing medications during last condom use event[A] and 20.0% out of 49 participants of men who used erection enhancing medications[A]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada and British Isles	22
Problems with fit or feel			
29.9% out of 278 participants at least once during last three events[A]	Men attending a public urban STI clinic	USA	54
20.6% (too tight) and 15.9% (too short) of 215 participants[A]	Men living with HIV at HIV service organisations	USA	55
21.0% (too tight), 10% (too loose), 18% (too short) and 7% (too long) out of 178 participants[B]	Survey data from African-American men who have sex with men attending an event	USA	56
44.7% out of 436 men for last condom use event[A]	Men recruited online for a questionnaire on condom use and erection enhancing substances	Predominantly USA, UK and Canada	23
18.9% out of 834 condom-protected events[B]	Men attending a public urban STI clinic	USA	20
9.0% (problems with fit) and 31% (problems with feel) out of 656 men who did not use erection enhancing drugs during last condom use event,[A] and 17.0% (problems with fit) and 41% (problems with feel) out of 49 participants who used erection enhancing drugs[A]	Men recruited from the mailing list of a large, internet-based sexual enhancement product company who reported condom use during last penile–vaginal sex	Predominantly USA, Canada, and British Isles	22

[A]past 3 months; [B]time not specified.

despite assumptions to the contrary, phosphodiesterase type 5 inhibitors do not fully overcome condom-associated erection problems.[22]

This initial review provides a guide to the literature. It is important to note that the prevalence estimates in the tables vary tremendously across studies. For example, breakage estimates ranged from less than 1% to more than one-third of events (see Table 3). Logically, estimates depend on the particular sample studied and the period assessed. Some are presented in terms of the number of participants experiencing the condom use error or problem and others in terms of the number of condom use events during which the condom use error and problem occurred. Some event level studies examined a single or specified number of events per person. Others included a range of number of events per person. This latter method can introduce some error in prevalence estimates. For example, one well established finding is that condom breakage is not a random event. A relatively small proportion of condom users experience a disproportionate number of breakages.[25,31,36,58,59] Therefore, analytic methods for event-level data should control for the number of reports per person. Both participant- and event-level prevalence estimates can be useful. One strength of event-level

analysis is the ability to infer causation. Participant-level analyses may help identify people experiencing multiple episodes of breakage or any other problem or error who may benefit from intensified intervention efforts.

A major limitation of the review is that the overwhelming majority of studies have been conducted in developed countries and mostly in North America. In fact, except for the studies focussed on breakage, slippage, leakage or condom failure (reported in Table 3), all of the studies on errors and other problems reported on participants predominantly from the USA, Canada or the British Isles. Therefore, more research is needed on condom use errors and problems in a wider range of countries, particularly in developing countries, and among varying populations. For example, reuse of condoms was rarely reported in the studies in this review, but may be more common in less economically developed countries or among the poor. Collecting data on condom use errors and problems among a larger diversity of populations may help better inform condom intervention strategies tailored to those populations.

Condom use promotion programs should emphasise that condoms must be used both consistently (on every occasion of intercourse) and correctly. The following guidelines for correct condom use, based largely on the recommendations of Hatcher *et al.*[4] are useful for clients and patients:

- Before intercourse. Plan ahead to use condoms and discuss condom use with your sexual partner(s). Have an adequate supply of latex (the most common type) or polyurethane condoms and water-based lubricant. Sufficient lubrication is important and more than one condom may be needed if one is damaged or put on incorrectly, for repeated intercourse or when switching behaviours such as from anal to vaginal intercourse. Do not reuse condoms.
- At time of intercourse.
  o *Opening the condom.* Check the date on the package and do not use expired condoms. Push the condom away from the corner of the package you are going to tear. When opening the package, carefully avoid contact with sharp objects including teeth and fingernails. Without unrolling it, inspect the condom for damage. Do not use a damaged or deteriorated condom (e.g. holes, brittle, discoloured, sticky) regardless of expiration date. Store condoms in a cool, dry place.
  o *Putting the condom on*: Put the condom on the penis before any contact with the partner's mouth, anus or vagina. If uncircumcised (uncut), pull back the foreskin before putting on the condom. Roll the condom slightly in your fingers to ascertain the direction to put it on so that the rolled ring will be on the outside and can unroll easily. Do not unroll the condom before putting it on. Place the condom on the tip of the erect penis and unroll a short distance to make sure it is being unrolled in the right direction. If the condom does not unroll easily, it is on upside down. If it is on upside down, dispose of that condom and start with a new one. (Pre-ejaculate ('pre-cum') may infect or impregnate a partner.) If the condom is unrolling properly, squeeze the tip to leave some space and unroll the condom to the base of the penis, smoothing out air as you unroll. Squeeze out excess air. If you see that the condom is damaged, change to a new one.
  o *Lubrication is important*. Even when lubricated condoms are used, additional lubricant can help avoid excessive friction that can be uncomfortable and may damage the condom. For latex condoms, only water-based lubricants (e.g. lubricating jellies; spermicidal creams, jellies, foam or suppositories; water; saliva) should be used. Oil-based lubricants can damage latex condoms. For polyurethane condoms, any type of lubricant can be used. In addition to placing additional lubricant on the outside of the condom or on the partner, some men find it helpful to place a small amount of lubricant in the tip of the condom before placing it on the penis.
  o *Protect the entire act of intercourse.* The condom should be put on the penis before intercourse and remain on the penis throughout intercourse (the entire time the penis is in contact with the vagina, anus or mouth). Avoid condom contact with sharp objects (including genital or mouth piercings) throughout use. Put on additional lubricant or change to a new condom for prolonged intercourse if desired. Change condoms between different types of intercourse (vaginal, oral, anal) within a session.
- After intercourse: Soon after ejaculation or when intercourse is over, hold the base of the condom during withdrawal to make sure it does not slip off or leak semen. Do not linger too long letting the penis get soft before withdrawal or semen may leak out. Check the condom for visible damage such as holes. Wrap it in tissue and discard. Do not flush condoms down the toilet.
- If the condom breaks, falls off, leaks or is not used during intercourse: If the condom breaks or slips off during intercourse and before ejaculation, stop and put on a new one before continuing intercourse. Even if ejaculation has not occurred, your partner may have been exposed to semen and infectious organisms. When a condom has broken or slipped off during intercourse or if a condom was not used for the complete act of intercourse, gently wash the penis, vulva, anus and surrounding areas with soap and water immediately after intercourse to reduce the risk of acquiring an STI. Insert an applicator full of spermicide in the vagina as soon as possible. Do not douche. Discuss the possibility of pregnancy or infection, and consult a health care provider as soon as you can to determine what action should be taken.

A review of the correlations among condom use errors and problems, consistency of condom use and contextual factors related to condom use is beyond the scope of this paper. However, given the prevalence of the errors and problems reviewed here, a framework for understanding their role in inadequate condom protection and possible avenues for further research and for intervention is warranted. As a way of conceptualising the inter-relationship of the errors and problems presented in this review within the larger context of condom use, we propose the Condom Use Experience (CUE) model, which focuses on the details of condom use experience within the context of other known predictors of condom use (Fig. 1).

Contextual factors (the left panel) include personal and situational variables such as information, attitudes (self and partner), motivation (self and partner), condom use self-

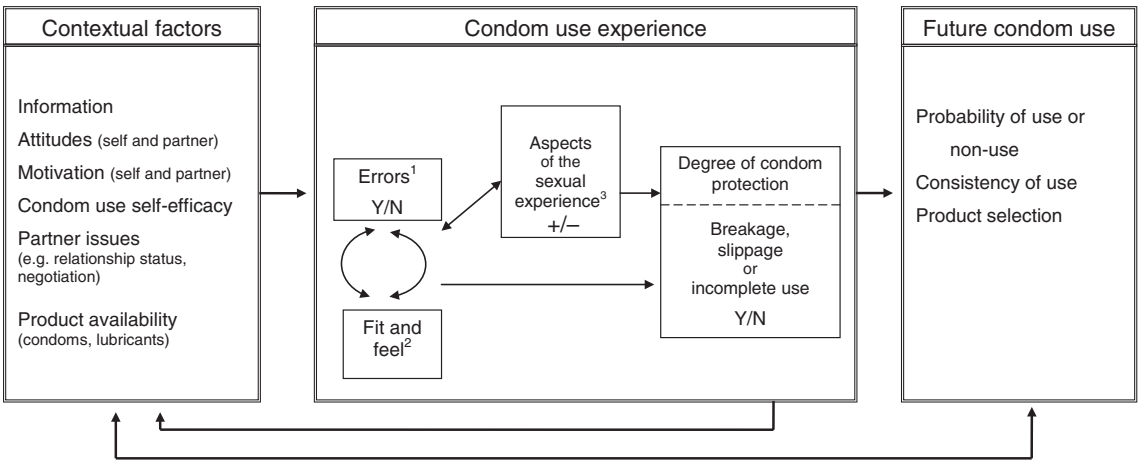

Fig. 1. The Condom Use Experience (CUE) model. Notes:[1] Errors are incorrect behaviours when using male condoms (e.g. including late application, early removal, completely unrolling the condom before putting it on, not leaving space at tip, not squeezing out air, putting the condom on wrong side up and then flipping it over, starting intercourse before the condom is unrolled to the base of the penis, using damaged or expired condoms, insufficient or inappropriate lubrication, not holding base of condom during withdrawal, and reusing a condom).[2] Fit and feel refer to how the condom fits the penis (e.g. good fit, too tight, too loose, too long, too short, mismatched shape) and how it feels for the man and his partner (e.g. comfortable or uncomfortable).[3] Aspects of the sexual experience refers to the physical aspects (e.g. type, duration and intensity of intercourse), the sensations (e.g. good, interference, distraction, pain, enjoyment, pleasure) and the sexual function aspects (e.g. arousal, erection, female lubrication, orgasm) of the condom use experience for the man and his partner.

efficacy, partner issues (e.g. relationship status, negotiation) and product availability (e.g. condoms, lubricants). These influence the probability that a condom will be used for a sexual event as well as the general pattern of future condom use.

Condom use experience during sexual events (the centre panel) mediates the relationship between contextual factors and future condom use. The condom use experience panel is the locus of the condom use errors and problems that are the topic of this review. Specifically, the model suggests that condom use errors (presence or absence; type) interact with issues of condom fit and feel (positive or negative) and that together these are predictive of the degree of condom protection during the event, either directly or mediated through the aspects of the sexual experience (e.g. duration and intensity of intercourse; sensations such as lack of stimulation, or discomfort and sexual arousal issues). For example, problems with fit and feel, or letting a condom touch a sharp object may lead to breakage. An uncomfortable condom may make erection problems more likely, which could lead to slippage or early removal (incomplete use). It is important to note that aspects of the sexual experience may also affect the fit and feel of the condom and whether it is used correctly. For example, lengthy intercourse may lead to condoms drying out, affecting the fit and feel of the condom. This could be dealt with by addition of lubricant or changing to a new condom. Failing to do this may lead to early removal of the condom, or condom breakage or slippage due to high friction compromising condom protection. The degree of condom protection component includes two types of highly correctable errors: incomplete use (delayed application and early removal) and slippage that occurs due to failure to hold the base of the condom during withdrawal. However, because these experiences can directly compromise the efficacy of condom use, we highlight them in the model as inadequate condom protection.

Future condom use (the right panel), including the probability of use or non-use, consistency of use and product selection, is affected by the quality of the condom use experience. For example, difficulties during the sexual experience including breakage, slippage and incomplete use affect the probability of condom use in the future as well as product selection, feeding back to contextual factors influencing future condom use events.

The CUE model provides a framework for understanding the role of user errors and problems in condom use, and generates testable hypotheses to guide future research. We acknowledge that our search strategy may not have identified all of the current relevant literature; selecting appropriate search terms for such a specific area of condom use was challenging. In the interest of serving researchers in this area, we have created an online resource that contains a 'living' compendium of citations on condom use errors and problems that currently includes the studies reviewed herein as well as reports published before 1995. We encourage researchers to inform us of their published findings so their citations can be added to the compendium (link on www.kinseyinstitute.org/research/condom_errors.html).

Closing the gap between perfect use and the errors characterising typical use is one of the most crucial challenges of future condom promotion programs. Researchers and intervention specialists alike should address common condom use errors and problems, including those related to fit and feel and aspects of the sexual experience. Doing so is critical to closing this gap and greatly reducing the epidemics of STIs and unintended pregnancies.

Conflicts of interest

None declared.

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