

Topical umbilical cord care at birth (Review)

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ABSTRACT

Background

Umbilical cord infection caused many neonatal deaths before aseptic techniques were used.

Objectives

To assess the effects of topical cord care in preventing cord infection, illness and death.

Search strategy

We searched the Cochrane Pregnancy and Childbirth Group trials register (September 2003) and the Cochrane Central Register of Controlled Trials (*The Cochrane Library*, Issue 2, 2003). We also contacted experts in the field.

Selection criteria

Randomized and quasi-randomized trials of topical cord care compared with no topical care, and comparisons between different forms of care.

Data collection and analysis

Two reviewers assessed trial quality and extracted data.

Main results

Twenty-one studies (8959 participants) were included, the majority of which were from high-income countries. No systemic infections or deaths were observed in any of the studies reviewed. No difference was demonstrated between cords treated with antiseptics compared with dry cord care or placebo. There was a trend to reduced colonization with antibiotics compared to topical antiseptics and no treatment. Antiseptics prolonged the time to cord separation. Use of antiseptics was associated with a reduction in maternal concern about the cord.

Authors' conclusions

Good trials in low-income settings are warranted. In high-income settings, there is limited research which has not shown an advantage of antibiotics or antiseptics over simply keeping the cord clean. Quality of evidence is low.

PLAIN LANGUAGE SUMMARY

No evidence that applying sprays, creams or powders are any better than keeping the baby's cord clean and dry at birth

The umbilical cord connects the baby to its food and oxygen supply in the womb, and is clamped and cut at birth. The cord stump dries, shrivels and becomes black before falling off the baby's belly button, five to 15 days after birth. Without proper care, the baby may become infected through the stump. Usually the cord is kept clean and dry by loosely covering it with clean clothes. Hand washing is critical. The review found that not enough trials had been done to show if antiseptics or antibiotics were any better at keeping infection away. More research is needed.

BACKGROUND

The umbilical cord which connects the baby and placenta *in utero* (the womb) is made of blood vessels and connective tissue. It is covered by a membrane which is bathed in amniotic fluid. After birth, cutting the cord physically and symbolically separates the mother and her baby. The cord stump dries, falls off and the wound heals.

As the umbilical stump dries, it shrivels turning black in colour. An area of separation forms between the drying cord and the abdominal wall in which polymorphonuclear leucocytes, a form of white blood cells, are present (OudesluysMurphy 1990). During the normal separation process, material may collect at this junction which sometimes looks like pus and is often wrongly identified as an infection. The cord usually separates between five and 15 days after birth. Before the separation, the remaining stump can be considered to be a healing wound and thus a possible route for infection through the vessels into the baby's blood stream.

Soon after a normal delivery, the skin of the newborn baby including the umbilical stump is colonized mainly by non-pathogenic (non-infection causing) bacteria such as coagulase-negative *Staphylococci* and *Diphtheroid* bacilli. Pathogenic bacteria such as *Coliforms* and *Streptococci* may also be present on the skin (Sarkany 1967) and can track up the umbilical stump causing infection. It is therefore essential to keep the cord clean.

An umbilical cord infection may be clinically obvious, but is also sometimes hidden. In frank infections, the cord may be swollen, the surrounding skin inflamed, or the cord may be 'smelly' if infected with anaerobic bacteria. Tracking of bacteria along the umbilical vessels is not obvious to the eye, but can cause septicaemia (blood poisoning), or result in other focal infections as a result of blood-borne spread such as septic arthritis (Cullen 1916; Forshall 1957). In such cases, affected babies may also present with fever, lethargy or poor feeding.

Cord cutting and care of the umbilical stump varies according to accepted practice and culture (Elhassani 1984). In many parts of the world the cord is cut with unsterile tools such as used razors or scissors after which various substances are applied including charcoal, grease, cow dung or dried banana to speed up cord separation. These practices are important sources of bacterial infection and neonatal tetanus (Bennett 1999; Meegan 2001).

While there is a general agreement about the 'clean' technique for cutting the cord using a sterile cutting instrument (blade or scissors) and clean hands to avoid infection, there is less agreement on what is the best care of the cord stump. Most frequent modern practice is applying antiseptic agents to the cord (usually alcohol, silver sulphadiazine, iodine, chlorhexidine; and dyes such as

triple dye, gentian violet, acriflavine and eozine). Some authorities recommend routine topical application of antibiotics, including bacitracin, neomycin, nitrofurazone, or tetracycline, or moisture absorbing powders. These may be used as solutions in water, alcohol, detergent or ointments.

A practice often forgotten is to do nothing other than keep the cord clean and dry without applying anything (Dore 1998; Mugford 1986).

Bathing the baby soon after birth with an antimicrobial such as hexachlorophene may reduce skin contamination. However, hexachlorophene is no longer recommended in new born babies as it is absorbed through the skin and is neurotoxic (WHO 1998a). Cord separation may be delayed by topical antimicrobials, premature delivery, caesarean section or low birthweight (Novack 1988; OudesluysMurphy 1987) which can potentially increase the risk of bacterial entry. Delays in cord separation increase the midwives' workload in countries where there is a policy of continued home visits until cord separation (Mugford 1986).

Other practices can significantly contribute to preventing infection in the early neonatal period. Rooming-in (nursing babies in rooms with their mothers) has been shown to be protective to babies who become colonized with their mothers' non-pathogenic bacteria as opposed to other harmful micro-organisms. This is now widely practiced in high-income countries (Enkin 2000).

Despite the advent of asepsis (Cullen 1916), umbilical cord infections continue to cause many deaths in neonates in low and middle-income countries (WHO 1998a). Contamination of the cord remains a common cause of neonatal tetanus in deprived populations (Thayaparan 1998; Woodruff 1984). Around 200,000 neonatal deaths (5%) that occur every year are the result of neonatal tetanus (WHO 1998b, CHRPSR 1999).

The World Health Organization and others emphasize good hygiene at delivery, and promote good cord care practice. However, recommendations for cord care are often based on traditional assessments of published literature and opinion. The aim of this review is to provide data useful for identifying good practice in both high and low-income countries. The findings of the original review were incorporated in a review summarizing available consensus on best and appropriate practice (WHO 1998a).

OBJECTIVES

To assess the effectiveness of topical cord care compared with no routine care, and comparisons between different forms of care, in preventing cord infection, illness and death.

In particular, to answer the following questions:

Is any intervention better than no routine cord care?

If so, which care is preferable:

- Antiseptic or no antiseptic?
- Antibiotic or no antibiotic?
- Antibiotic or antiseptic?

For any intervention, what is the optimal frequency, formulation and duration of application?

Hypotheses to be explored:

1. Cord antiseptics or antibiotics are effective in reducing neonatal infection and death when babies are nursed together in a nursery but are less likely to have an impact on health when babies are roomed-in or nursed at home.
2. When people are living in poverty such that basic hygiene at home delivery and postnatally is constrained, cord antiseptics or antibiotics are more likely to have an impact on serious illness or death in the neonate.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Randomized or quasi-randomized trials.

Types of participants

Newborn infants of any gestation.

Types of intervention

1. Antiseptic versus no antiseptic or placebo;
 2. antibiotic versus no antibiotic or placebo;
 3. antibiotic versus antiseptic;
 4. antiseptic versus antiseptic;
 5. antibiotic versus antibiotic;
 6. single versus multiple applications;
 7. washing the cord versus dry care.
- All interventions must be topical preparations; to be excluded if the intervention is a combination of an antiseptic and antibiotic.
 - Antiseptics to include alcohol, triple dye, silver sulphadiazine, acriflavine, iodine, chlorhexidine, gentian violet.
 - Antibiotics to include bacitracin, nitrofurazone, or tetracycline.

Types of outcome measures

Primary

1. Clinical evidence of local cord infection: redness, swelling, smell;
2. clinical evidence of disseminated bacterial infection: fever, meningitis, septic foci;
3. death.

Secondary

1. Time to cord separation;
2. bacterial colonization;
3. mother unhappy with treatment.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

We searched the Cochrane Pregnancy and Childbirth Group trials register (September 2003).

The Cochrane Pregnancy and Childbirth Group's trials register is maintained by the Trials Search Co-ordinator and contains trials identified from:

1. quarterly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. monthly searches of MEDLINE;
3. handsearches of 30 journals and the proceedings of major conferences;
4. weekly current awareness search of a further 37 journals.

Details of the search strategies for CENTRAL and MEDLINE, the list of handsearched journals and conference proceedings, and the list of journals reviewed via the current awareness service can be found in the 'Search strategies for identification of studies' section within the editorial information about the Cochrane Pregnancy and Childbirth Group.

Trials identified through the searching activities described above are given a code (or codes) depending on the topic. The codes are linked to review topics. The Trials Search Co-ordinator searches the register for each review using these codes rather than keywords.

In addition, we searched the Central Register of Controlled Trials (*The Cochrane Library*, Issue 2, 2003) using the search term umbilical cord*.

We contacted the World Health Organization and experts and individual researchers working in the field.

METHODS OF THE REVIEW

Two reviewers scrutinized all eligible papers and applied the inclusion criteria independently. If there had been disagreement, consultation with a third person (an editor in the Pregnancy and Childbirth Group) would have been sought.

Concealment of allocation was graded as: A - adequate measures used such as opaque envelopes, independent number generation; B - uncertainty, whether or not allocation was adequately concealed; C - allocation not adequately concealed; and D - score not assigned.

We recorded the number of participants experiencing the event in each group of the trial for binary outcomes. For continuous

outcomes (such as time to cord separation), we recorded the arithmetic means and standard deviations and we combined means using the weighted mean difference.

The results were analyzed using relative risks and a fixed effect model. Heterogeneity was checked first visually and then by the I^2 statistic and the decision to use a random effects model was taken on a case by case basis.

Potential causes of heterogeneity for exploration using subgroup analysis:

1. Frequency of intervention (single at birth; every nappy change);
2. duration (until discharged; until cord separation);
3. formulation (aqueous based; alcohol based; powder; spray dressing);
4. maturity (full-term versus premature).

The time when the trials were conducted could also be a factor since the patterns of newborn care (feeding, nursing, rooming-in) have changed significantly over the past 25 years.

DESCRIPTION OF STUDIES

Twenty-one studies met the inclusion criteria (*see* 'Characteristics of included studies'). These were conducted in Canada (4), Israel (1), Italy (1), Norway (2), Spain (1), Taiwan (1), Thailand (1), UK (2) and USA (8). One study was published in Spanish (Perapoch 1993). The 23 excluded studies are listed in 'Characteristics of excluded studies'.

There were two large studies with over 1200 infants (Meberg 1990; Pezzati 2002) and the largest trial (Pezzati 2002) compared eight treatments in 1470 infants. Most of the studies were small with comparator groups of less than 300.

Nineteen studies were on full-term infants and excluded those who were small for gestational age or had other neonatal conditions. Two studies were on preterm infants (Bain 1994; Rosenfeld 1990). Babies were nursed in hospital initially and most were followed up at home. Rooming-in was practised in six studies (Barrett 1979; Dore 1998; Meberg 1985; Meberg 1990; Rush 1986; Wald 1977) but this was partial rooming-in as most of the babies were also cared for in the nursery.

Interventions

Twelve studies had more than two arms and numerous comparisons between antiseptics and antibiotics were used (Table 01). Eight studies compared various antiseptics with no specific care (Bain 1994; Barrett 1979; Dore 1998; Meberg 1985; Medves 1997; Pezzati 2002; Speck 1980; Wald 1977). Ten studies compared antiseptics with other antiseptics (Arad 1981; Barrett 1979; Gladstone 1988; Panyavudhikrai 2002a; Panyavudhikrai 2002b; Perapoch 1993; Pezzati 2002; Rosenfeld 1990; Schuman 1985; Speck 1980). One study compared antibiotics with triple dye

(Arad 1981). One study each compared antiseptic powder with astringent powder (Mugford 1986); and antiseptic with hydrophobic gauze dressing (Meberg 1990). One study compared daily bathing versus one initial bath and no additional cord care (Rush 1986).

There were various other cleaning co-interventions which were applied to both groups such as an initial bath (with soap, chlorhexidine or hexachlorophane) or daily bathing. In several studies alcohol was used to clean the umbilical stump following discharge home. Generally, treatment to the umbilical stump continued for a few days after or was stopped at cord separation.

Outcomes (Table 02)

Twelve studies reported cord infections; seven studies reported disseminated infections; one study reported deaths; twelve reported time of cord separation; eleven studies reported bacterial colonisation; and three studies reported parental satisfaction.

METHODOLOGICAL QUALITY

All studies were described as randomized. Generation of allocation was by computer (Barrett 1979; Schuman 1985); and random tables (Dore 1998; Gladstone 1988). Six trials were quasi-randomized using: alternate allocation (Golombek 2002; Meberg 1990; Rosenfeld 1990; Wald 1977); the time of admission (Pezzati 2002); and the cot ID number (Rush 1986). Three trials with adequate allocation concealment used envelopes (Dore 1998; Janssen 2003; Mugford 1986).

As follow-up times were generally up to separation of the cord, losses to follow up appeared minimal. Three studies continued follow up to six weeks (Meberg 1985; Meberg 1990; Wald 1977).

RESULTS

Twenty-one studies with 8959 participants met the inclusion criteria.

Antiseptic versus dry cord care/placebo

Ten studies had treatment arms with this comparison. These compared dry cord care/placebo with: alcohol (Bain 1994; Dore 1998; Medves 1997; Pezzati 2002); triple dye (Barrett 1979; Speck 1980; Wald 1977); silver sulfadiazene (Barrett 1979; Speck 1980); and in one study each, zinc powder (Mugford 1986); chlorhexidine (Meberg 1985) and salicylic sugar powder; green clay powder; kaolin powder; and fuschine (all Pezzati 2002).

No deaths were reported in the single study reporting this outcome (Pezzati 2002). No severe bacterial systemic infections occurred in the two trials reporting this outcome (Meberg 1985; Pezzati 2002).

Two trials using alcohol as the comparator found no difference in cord infections (two trials; relative risk (RR) 0.63, 95% confidence interval (CI) 0.19 to 2.06; Bain 1994; Pezzati 2002). There was no significant difference in the incidence of cord infection with triple dye; chlorhexidine; salicylic sugar powder; green clay powder; katoxin powder; and fuschine compared with dry cord care/placebo. One study reported no cord infection in either group (Dore 1998). There was no significant difference in cord infection whether topical antiseptic was used or not (RR 0.53, 95% CI 0.25 to 1.13).

Meta-analysis of four studies with alcohol as the comparator showed a trend towards cord separation being significantly later in the alcohol group but there was considerable heterogeneity (random effects, weighted mean difference (WMD) 3.51, 95% CI -0.41 to 7.43, test for heterogeneity $p < 0.00001$). Sensitivity analysis excluding the study with premature babies (Bain 1994) did not affect this result (three trials, random effects, WMD 4.54, 95% CI -0.49 to 9.57, test for heterogeneity $p < 0.00001$). Cord separation time was longer with triple dye (WMD 4.10, 95% CI 3.07 to 5.13) and fuschine (WMD 2.80, 95% CI 2.01 to 3.59). Time to cord separation was generally shorter with powder applications: zinc (WMD -1.82, 95% CI -2.23 to -1.41; Mugford 1986); salicylic sugar (WMD -1.90, 95% CI -2.47 to -1.33); and green clay (WMD -0.80, 95% CI -1.36 to -0.24).

Compared with dry cord care/placebo, bacterial colonization by *Staphylococcus aureus* was significantly reduced by alcohol (RR 0.30, 95% CI 0.16 to 0.55); triple dye (three trials, RR 0.14, 95% CI 0.10 to 0.20); silver sulfadiazene (two trials: RR 0.72, 95% CI 0.59 to 0.87); chlorhexidine (RR 0.65, 95% CI 0.55 to 0.77); salicylic sugar powder (RR 0.32, 95% CI 0.17 to 0.58); green clay powder (RR 0.51, 95% CI 0.31 to 0.82); and fuschine (RR 0.52, 95% CI 0.32 to 0.84). Bacterial colonization by *Streptococci* was significantly reduced by alcohol (RR 0.20, 95% CI 0.04 to 0.89); triple dye (four trials: RR 0.57, 95% CI 0.44 to 0.73); silver sulfadiazene (two trials, RR 0.60, 95% CI 0.42 to 0.85) and fuschine (RR 0.19, 95% CI 0.04 to 0.85). *Escherichia coli* colonization was significantly reduced by triple dye (two trials: RR 0.76, 95% CI 0.63 to 0.91), silver sulfadiazene (RR 0.70, 95% CI 0.53 to 0.93) and chlorhexidine (RR 0.48, 95% CI 0.27 to 0.85).

More babies treated with green clay powder (RR 4.62, 95% CI 2.41 to 8.84) and katoxin powder (RR 5.87, 95% CI 3.12 to 11.05) were colonized by *Streptococci*. More infants treated with fuschine were colonized by *Escherichia coli* (RR 2.04, 95% CI 1.33 to 3.13).

Two studies using alcohol as the comparator reported parental satisfaction (Dore 1998; Pezzati 2002). There was no difference in maternal satisfaction in Dore 1998 mean score 1.49 (standard deviation (SD) 0.7) alcohol group versus 1.56 (SD 0.7) in the no alcohol group; $t = -2.13$, p -value not significant, authors' calculation.) In Pezzati 2002, parents in the natural drying group were more satisfied with the treatment (RR 0.55, 95% confidence interval 0.45 to 0.66).

Antiseptic versus antibiotic

Two studies had treatment arms comparing: triple dye with neomycin (Arad 1981); triple dye with bacitracin (Gladstone 1988); silver sulfadiazene with neomycin (Arad 1981); silver sulfadiazene with bacitracin (Gladstone 1988); and povidone-iodine with bacitracin (Gladstone 1988).

No clinical infections were reported in either study.

There was a trend to reduced colonization with *Staphylococcus aureus* with antibiotics compared with antiseptics (Gladstone 1988).

There was a trend towards time for cord separation being shorter with antiseptics compared with antibiotics. Time to cord separation was significantly shorter with triple dye compared to bacitracin (WMD -5.60, 95% CI -9.36 to -1.84; Gladstone 1988) and neomycin (WMD -4.30, 95% CI -6.27 to -2.33; Arad 1981) and for povidone-iodine compared with bacitracin (WMD -2.00, 95% CI -3.67 to -0.33). Cord separation time was significantly longer with silver sulfadiazene compared with bacitracin (WMD 2.00, 95% CI 0.20 to 3.80).

Antiseptic versus antiseptic

Triple dye versus other antiseptic

Seven studies had treatment arms that compared triple dye with: silver sulphadiazine (Barrett 1979; Gladstone 1988); alcohol (Golombek 2002; Panyavudhikrai 2002a; Panyavudhikrai 2002b; Rosenfeld 1990; Schuman 1985); and povidone-iodine (Gladstone 1988; Panyavudhikrai 2002a). Pezzati 2002 compared triple dye with six other antiseptics.

Fewer cord infections were reported with triple dye when compared with alcohol (four trials, RR 0.30, 95% CI 0.19 to 0.49) and povidone-iodine (RR 0.15, 95% CI 0.07 to 0.32; Panyavudhikrai 2002a).

Fewer babies treated with triple dye were colonized with *Staphylococcus aureus* compared with alcohol (two trials RR 0.45, 95% CI 0.25 to 0.81; Pezzati 2002; Rosenfeld 1990) or silver sulfadiazine (two trials RR 0.28, 95% CI 0.17 to 0.46). More babies treated with triple dye were colonized with *Escherichia coli* compared with other antiseptics.

Two trials (Pezzati 2002; Schuman 1985) reporting cord separation with triple dye in comparison with alcohol gave opposite results and should be analysed separately because of considerable heterogeneity ($p < 0.00001$, random effects). Schuman 1985 was considerably smaller with 71 babies compared with 373 babies in Pezzati 2002. Similarly, two other trials comparing triple dye with silver sulfadiazene (Arad 1981; Gladstone 1988) also reported opposite results and were not combined because of significant heterogeneity ($p < 0.002$). Both the studies were small. Authors in Golombek 2002 comparing triple dye with alcohol reported median cord separation times as 13 days ($n = 326$; range 2 to 37) with triple dye compared to 10 days ($n = 273$, range 2 to 34) with alcohol ($p < 0.0001$, authors' calculation). Cord separation time

was significantly longer with triple dye compared to povidone-iodine (WMD 7.60, 95% CI 3.96 to 11.24; Gladstone 1988).

Povidone-iodine versus other antiseptic

Two trials had treatment arms comparing povidone-iodine with: silver sulfadiazine (Gladstone 1988); alcohol (Panyavudhikrai 2002a); and triple dye (Panyavudhikrai 2002a).

There was no difference in cord infection between povidone-iodine and alcohol (RR 1.18, 95% CI 0.87 to 1.62; Panyavudhikrai 2002a). More cord infections were seen with povidone-iodine compared to triple dye (RR 0.15, 95% CI 0.07 to 0.32; Panyavudhikrai 2002a).

Cord separation time with povidone-iodine was significantly shorter compared with silver sulfadiazine (WMD -4.00, 95% CI -5.53 to -2.47) and triple dye (WMD -7.6, 95% CI -3.96 to -11.24).

Chlorhexidine versus other antiseptic

Two studies had treatment arms comparing chlorhexidine with: hydrophobic gauze (Meberg 1990); alcohol (Perapoch 1993); and mercurochrome (Perapoch 1993).

Perapoch 1993 reported cord infections and none occurred in any group. More cord infections were seen with chlorhexidine compared to hydrophobic gauze (RR 1.36, 95% CI 0.55 to 3.36; Meberg 1990).

Cord separation time was significantly shorter with chlorhexidine compared with hydrophobic gauze (WMD -0.4, 95% CI -0.57 to -0.23). Cord separation time was significantly longer with chlorhexidine in comparison with alcohol (WMD -5.70, 95% CI -6.82 to -4.58); and mercurochrome (WMD 6.40, 95% CI 5.25 to 7.55).

Single versus multiple applications

Three studies compared single and multiple applications with: triple dye (Gladstone 1988; Hsu 1999) and dusting powders (Mugford 1986). Triple dye was applied once at birth or daily. Alcohol was also applied daily in addition to the triple dye in Hsu 1999.

Both trials using triple dye reported no cord or skin infections.

Cord separation was significantly prolonged with multiple applications of triple dye (two trials, WMD -4.27, 95% CI 5.48 to -3.05). There was no difference in cord separation time with the dusting powders (WMD -0.02, 95% CI -0.31 to 0.27).

One trial reported no difference in colonization by *Staphylococcus aureus* (Gladstone 1988).

Mothers were equally satisfied with both treatments in Gladstone 1988.

Impact on various specific outcomes

Cord separation (in days)

Summary analysis was explored with three comparisons but there was significant heterogeneity:

- Alcohol versus dry cord care/placebo (Bain 1994; Dore 1998; Medves 1997; Pezzati 2002): The trend was towards cord separation being prolonged in the alcohol group but there was no significant difference in cord separation and considerable heterogeneity (four trials, WMD 3.51, 95% CI -0.41 to 7.43, test for heterogeneity $p < 0.00001$, random effects). Sensitivity analysis excluding the study with premature babies (Bain 1994) did not change this result (three trials, WMD 4.54, 95% CI -0.49 to 9.57, test for heterogeneity $p < 0.00001$, random effects).
- Triple dye versus alcohol (Pezzati 2002; Schuman 1985): There was no significant difference in cord separation (two trials, WMD -0.16, 95% CI -10.25 to 9.94, test for heterogeneity $p < 0.00001$, random effects).
- Triple dye versus silver sulfadiazine (Arad 1981; Gladstone 1988): There was no significant difference in cord separation (two trials, WMD 0.15, 95% CI -6.2 to 6.5, test for heterogeneity $p < 0.002$, random effects).

Studies which applied nothing to the cord had mean separation times of about nine days (four studies: Bain 1994; Dore 1998; Medves 1997; Pezzati 2002); with powders it was about seven (four studies: Arad 1981; Bain 1994; Mugford 1986; Pezzati 2002); alcohol it was about 11 days (six studies: Bain 1994; Dore 1998; Medves 1997; Perapoch 1993; Pezzati 2002; Schuman 1985); antibiotics, about 12 days (two studies: Arad 1981; Gladstone 1988); triple dye, about 14 days (six studies: Arad 1981; Gladstone 1988; Hsu 1999; Panyavudhikrai 2002b; Pezzati 2002; Schuman 1985); and silver sulphadiazine, about 12 days (two studies: Arad 1981; Gladstone 1988) (See Table 03).

Examining the impact of interventions on these times suggests that alcohol or powder when compared with nothing have a minimal impact on separation times except in one study (Pezzati 2002), where daily alcohol applications more than doubled the time before separation compared to natural drying or antimicrobial powders. In one large study (Dore 1998), separation time was significantly shorter with alcohol but the time difference was only 1.8 days.

DISCUSSION

There were few trials, considering the millions of newborns whose umbilical cords are treated with topical applications. All but two of the trials were conducted in high-income countries, despite the fact that most neonatal deaths occur in low- and middle-income countries where a significant proportion are due to tetanus associated with sub-optimal cord care.

Most of the trials did not report our outcomes of interest as well as factors affecting methodological quality. We were, therefore, not

able to assess trial quality. Follow up was generally to cord separation and outcomes subsequent to this (such as bacterial infection, whether local or generalized) would not have been detected. One of the studies that routinely followed all infants up to six weeks (Meberg 1985) showed relatively high levels of skin infections of various kinds, but there were no differences between the intervention and treatment group.

Over 40 different comparisons were seen with few trials using the same antiseptics or antibiotics. Meta-analysis was therefore limited to few outcomes. Antiseptics such as triple dye; alcohol; silver sulfadiazene; and povidone-iodine were used more frequently than antibiotics. This may be because their role is seen as more preventative than curative as antiseptics inhibit micro-organisms and don't necessarily kill them whereas antibiotics both inhibit and kill micro-organisms. Another important factor could be that antiseptics are cheaper than antibiotics.

Most trials reported on umbilical cord infections. They were rare. Information on disseminated infections as well as other topical infections (such as skin and eye infections) was limited. Death as an outcome was only reported in one study, which is probably because most of the trials were conducted in high-income countries where neonatal mortality rates are low.

Eleven studies examined colonization of the skin. Measurement and reporting of these outcomes varied between studies, and was sometimes difficult to interpret. Colonization was reduced with antibiotic and antiseptic use, but the clinical significance of skin colonization is not known.

There were trends towards shorter cord separation times with no topical care compared to antiseptics, and shorter separation times with powder preparations compared to no intervention. Multiple applications compared to single applications of triple dye prolonged cord separation time in one trial. The clinical impact of delays of cord separation is unknown, but it has social and cost implications: delay makes mothers anxious, and increases the number of domiciliary midwife visits to the home (Mugford 1986).

Two studies were on well preterm infants. Such infants are at higher risk of infection because of their prematurity and are also have a higher risk of nosocomial infections. Prematurity is associated with longer cord separation times but there was no difference when alcohol was compared to placebo (Bain 1994). One trial specifically looked at bacterial colonization by methicillin-resistant *Staphylococcus aureus* (MRSA) which was significantly reduced by triple dye compared with alcohol. None of the two trials reported on the potential risk of the topical antiseptic/antibiotic being absorbed systemically (percutaneous absorption) (Aggett 1981), which is associated with prematurity. As the trials were small, it is difficult to know how the findings relate to this particular subgroup of infants. Larger studies should be conducted in future.

Overall care fashions have changed over the period of the studies reviewed, and this is likely to impact on the comparative effec-

tiveness of various interventions. For example, there has been a shift from nursery care to rooming-in high-income countries, thus reducing the risk of infection.

Much of the concern from mothers and health workers relates to uncertainty about the normal process of drying and separation, including appearance and odour of decomposing tissue. Interventions in the West mainly relate to modifying this process in some way. Oudesluys-Murphy et al described the histological findings during normal drying and separation of the umbilical stump and the perinatal factors modifying the process (OudesluysMurphy 1987; OudesluysMurphy 1990). Good research documenting the range of clinical variations of this normal process of cord separation is required.

AUTHORS' CONCLUSIONS

Implications for practice

Based on the studies meeting the inclusion criteria for this review, we are unable to be sure what is best practice for cord care in institutions and at home in high-income countries. Studies to date have insufficient evidence to know whether antiseptics or antibiotics have any additional advantage over keeping the cord clean and dry. Cord separation time with no topical care was shorter. Since home visits for cord care in developed countries may need to be frequent, earlier separation of the cord stump could decrease the need for the visits and thus reduce cost of postnatal care (Mugford 1986).

Some infants are at high risk of infection in hospital (such as premature babies or babies nursed on intensive care units). We identified two trials with premature babies. Given the higher risk of bacterial sepsis in these infants, use of antiseptics is unlikely to be harmful, and has the potential for reducing nosocomial infection by reducing umbilical cord and skin colonization.

This review provides no evidence on best cord care practice for settings where babies are at a higher risk of bacterial contamination of the cord such as those delivered in sub-optimal hygienic conditions either at home or in institutions in poor-resource countries or where harmful cord care practices prevail. Where the risk of bacterial infection appears high it might be prudent to use topical antiseptics. However, quality of evidence is not adequate to recommend the best antiseptic and the regimen for cord care. It would seem sensible, in situations where packages of care around improving umbilical cord sepsis are introduced, to conduct randomized comparisons to identify the best agents and regimens.

Implications for research

In high-income countries, where mortality is very low, important outcomes must include infections in the first month of life, maternal satisfaction, and time to cord separation. There is a good

argument to conduct a study of existing inexpensive interventions with no specific topical cord care.

In low- and middle- income countries, neonates have a much higher risk of infection resulting in serious illness or death. The cord probably remains an important portal for bacteria, as demonstrated by neonatal tetanus. However, we still do not know what is the best cord care: what are the most appropriate agents (alcohol, antiseptics or antibiotics; powders, solutions or ointments) for routine use, and how often they should be applied. Any agent should be easily available, inexpensive and easy to apply. We also do not know what the best method is for cleaning the cord area. Trials should also address the best ways for replacing harmful cord practices.

Trials in low- and middle- income countries should be part of a package of care promoting good hygiene at delivery and until the cord separation in deprived areas where hygiene remains a problem. Within such an intervention programme, groups of women could be randomized to receive different preparations for the cord. The first set of trials could compare water and soap with an antiseptic (such as chlorhexidine, iodine or powders). Harmful effects of antimicrobials such as effect of iodine on thyroid gland function and possible interference with neonatal screening for congenital hypothyroidism, should be taken into account.

One potential intervention for cord care is colostrum which has bacteriostatic properties and could be applied to the cord stump. No research has been done and future trials should consider using this as one intervention arm.

POTENTIAL CONFLICT OF INTEREST

None known.

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T A B L E S**Characteristics of included studies**

Study	Arad 1981
Methods	'Randomly assigned'.
Participants	Inborn, healthy term babies (36, 26, 25 and 34 in each experimental group). Hospital nursery. caesarean section births included.
Interventions	Initial bath. Daily application during hospital stay. 1. Triple dye 2. Neomycin ointment 3. Sulphadiazine ointment 4. Bismuth powder. Daily alcohol applied at home.
Outcomes	Separation time. Infection.
Notes	Israel 1980.
Allocation concealment	B – Unclear

Study **Bain 1994**

Methods	Randomization not described.
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Characteristics of included studies (Continued)

Participants	Inborn, premature babies > 1000 g. Excluded if had umbilical line or abdominal surgery (26, 24, 24, 28 in each experimental group).
Interventions	No information about initial bath 1. Alcohol wipe (Steret) +hexachlorophane and 3% zinc powder (Ster-zac) 2. Ster-zac 3. Sterets 4. Nothing.
Outcomes	Separation time. Infection with negative swabs. Positive second bacterial swab.
Notes	Scotland 1991-2. Some babies received antibiotics.
Allocation concealment	B – Unclear

Study **Barrett 1979**

Methods	Computer generated random numbers.
Participants	Inborn, hospital nursery (100 in each group). Some infants partial rooming-in.
Interventions	Initial bath. 1. Silver sulphadiazine, single application 2. Triple dye, single application 3. Dry cord care.
Outcomes	Colonization of periumbilical area and anterior nares at 48 hours.
Notes	USA 1976.
Allocation concealment	B – Unclear

Study **Dore 1998**

Methods	Table of random numbers. Opaque envelopes.
Participants	Inborn, healthy term infants (902 experimental, 909 control). caesarean section births included. Rooming-in.
Interventions	Initial bath. 1. 70% isopropyl alcohol at least three times a day 2. Natural drying.
Outcomes	Umbilical infection. Separation time. Maternal satisfaction.
Notes	Canada 1995-6. Two sites. Includes cost data. Loss to follow-up: 65, equally divided between the two groups. 'High level of breast feeding'.
Allocation concealment	A – Adequate

Study **Gladstone 1988**

Methods	Table of random numbers.
Participants	Inborn healthy term infants > 2500 g (53, 48, 44, 42, and 48 in each group).

Characteristics of included studies (Continued)

	Hospital nursery.
Interventions	No information about initial bath 1. Triple dye once daily until separation 2. Triple dye once then alcohol until separation 3. Triple dye once only 4. Povidone iodine daily until separation 5. Silver sulphadiazine daily until separation 6. Bacitracin ointment until cord separation.
Outcomes	Colonization at discharge from hospital. Separation time. Maternal satisfaction. Local or other infections. Nursing staff satisfaction.
Notes	USA.
Allocation concealment	B – Unclear

Study Golombek 2002

Methods	Randomized using alternate months.
Participants	Inborn healthy term infants (273, 326).
Interventions	No information about initial bath 1. Alcohol 2. Triple dye.
Outcomes	Cord infection. Cord separation. Nursing staff satisfaction.
Notes	USA 1998-1999.
Allocation concealment	D – Not used

Study Hsu 1999

Methods	Randomization not described.
Participants	Inborn healthy term infants (101 experimental, 79 control). Hospital nursery.
Interventions	Daily whole body wash with soap. 1. Triple dye, single application 2. Triple dye, daily application.
Outcomes	Separation time. Infection.
Notes	Taiwan 1995-6
Allocation concealment	B – Unclear

Study Janssen 2003

Methods	Randomization stratified according to clinical area in which infant resided. Adequate concealment.
Participants	Inborn healthy infants (384, 382). Rooming in.
Interventions	No information about initial bath 1. Triple dye - 2 applications then alcohol thrice daily 2. Dry cord care

Characteristics of included studies (Continued)

	Both groups had daily bath.
Outcomes	Omphalitis. Staphylococcus aureus induced conjunctivitis or skin infection. Bacterial colonization.
Notes	Canada.
Allocation concealment	A – Adequate

Study Meberg 1985

Methods	'Consecutively and randomly selected'.
Participants	Inborn healthy term infants (113 and 112 experimental, 108 control). Hospital ward. Day rooming-in. Cesarean section births excluded.
Interventions	Phase I: Daily whole body soap wash 1. Benzine daily 2. Chlorhexidine (0.05%) daily 3. No specific care.
Outcomes	Colonization of stump at discharge. Infection (umbilical and severe) within six weeks.
Notes	Norway. Phase 1: 1982; Phase 2: 1983. Roomed-in with mothers.
Allocation concealment	B – Unclear

Study Meberg 1990

Methods	Consecutive birth numbers with alternate allocation. (even/odd).
Participants	Hospital births (1213 experimental, 1228 control). Day time rooming-in.
Interventions	Daily whole body soap wash. 1. Hydrophobic gauze material bandage, applied daily 2. Chlorhexidine in alcohol, applied daily.
Outcomes	Infections of skin, cord, eyes during stay and at six weeks. Separation time.
Notes	Norway 1987-1989.
Allocation concealment	C – Inadequate

Study Medves 1997

Methods	Block randomization.
Participants	Inborn healthy term infants. (71 experimental, 65 control).
Interventions	Initial bath. 1. Isopropyl alcohol 2. Sterile water
Outcomes	Separation time. Colonization at birth and within 12 hrs of cord separation.
Notes	Canada 1996.

Characteristics of included studies (Continued)

'Intention to treat'	
Allocation concealment	B – Unclear
Study	
Mugford 1986	
Methods	Open randomized factorial design. Numbered sealed envelopes.
Participants	Inborn babies and likely to receive normal postnatal care (199, 202, 197 experimental, 202 control).
Interventions	Factor 1: Powder 1. Zinc/starch/talc 2. Sterzac (hexochlorophane, zinc and starch) 3. Cordocel 4. No powder. Factor 2: cleansing method: 1. Spirit 2. Water 3. No routine cleansing. Factor 3: frequency of treatment: 1. Daily 2. Once only.
Outcomes	Use of additional cord treatments. Midwife visits after day 10. Separation time. Days of cord moisture and stickiness.
Notes	United Kingdom 1984.
Allocation concealment	A – Adequate
Study	
Panyavudhikrai 2002a	
Methods	'Simple randomization'.
Participants	Inborn healthy term infants (93, 90, 89 in each group).
Interventions	Phase 1 1. Povidone -iodine twice daily 2. Triple dye twice daily 3. Alcohol (70%) twice daily.
Outcomes	Cord infection.
Notes	Thailand. Phase 1: Nov - Dec 1998
Allocation concealment	B – Unclear
Study	
Panyavudhikrai 2002b	
Methods	'Simple randomization'.
Participants	Inborn healthy term infants (213 and 214).
Interventions	Phase 2 1. Triple dye twice daily 2. Alcohol (70%) twice daily.
Outcomes	Cord infection.
Notes	Thailand. Phase 2: Dec 1998

Characteristics of included studies (Continued)

Allocation concealment B – Unclear

Study Perapoch 1993

Methods	Randomization not described.
Participants	Inborn healthy term infants (75, 84, 78, 74 in each group).
Interventions	No information about initial bath 1. Alcohol (70%) 2. Alcohol + mercurochrome 3. Mercurochrome 4. Chlorhexidine (1%).
Outcomes	Cord infection. Cord separation. Bacterial colonization.

Notes

Allocation concealment D – Not used

Study Pezzati 2002

Methods	Randomized by month of admission.
Participants	Inborn healthy term infants (167, 184, 177, 208, 174, 187, 195, 178).
Interventions	Initial bath with soap. 1. Salicylic sugar powder 2. Green clay powder 3. Natural drying 4. Katoxin 5. Cicatrene 6. 1% basic fuschine 7. Triple dye 8. 70% alcohol
Outcomes	Sepsis. Death. Cord infection. Cord separation. Cord bleeding. Compliance. Parental satisfaction. Bacterial colonization.

Notes Italy 1999.

Allocation concealment D – Not used

Study Rosenfeld 1990

Methods	Alternate allocation.
Participants	Premature babies < 2200 g (54 experimental, 60 control). Hospital nursery.
Interventions	Initial bath with soap. 1. Triple dye, single application 2. Isopropyl alcohol each diaper change
Outcomes	Colonization on day 4 and at discharge.

Characteristics of included studies (*Continued*)

Notes	USA 1988.
Allocation concealment	C – Inadequate

Study	Rush 1986
Methods	Random allocation by 'cot ID'.
Participants	Healthy term newborn infants (95 experimental, 86 control). Rooming-in.
Interventions	1. Routine daily bath with water and soap 2. Initial bath only.
Outcomes	Colonization on day 4 in the nose and umbilicus.
Notes	Canada 1984.
Allocation concealment	B – Unclear

Study	Schuman 1985
Methods	Computer generated random numbers.
Participants	Inborn healthy, term babies Hospital nursery (35 experimental, 36 control). caesarean section birth included.
Interventions	Daily bath with Phisoderm 1. Triple dye 2. Isopropyl alcohol After discharge, isopropyl alcohol in both groups.
Outcomes	Separation time. Cord infection.
Notes	USA 1983.
Allocation concealment	B – Unclear

Study	Speck 1980
Methods	'Randomly assigned'.
Participants	Inborn healthy term babies (80 and 82 experimental, 78 control). Hospital nursery. Complicated labour and caesarean births excluded.
Interventions	Initial bath. 1. Daily wash with castile soap 2. Triple dye 3. Silver sulphadiazine. Routine daily sponge bath with tap water. After discharge, daily application of isopropanol.
Outcomes	Bacterial culture from the nose day 3, 14. Cord infection. Conjunctivitis. Impetigo.
Notes	USA 1975-76.
Allocation concealment	B – Unclear

Study	Wald 1977
Methods	Babies with same intervention admitted to one room. Room assignments rotated after every 100 infants admitted.
Participants	Inborn healthy term babies (409, 197, 199). Hospital nursery with partial rooming-in.
Interventions	No initial bath. 1. Triple dye 2. Hexachlorophene 3. Control.
Outcomes	Bacterial colonization with Group B streptococci.
Notes	USA 1974. Treatment arm using hexachlorophene excluded from review.
Allocation concealment	D – Not used

Characteristics of excluded studies

Study	Reason for exclusion
Alder 1980	Comparison between hexachlorophene and chlorhexidine. Hexachlorophene not recommended anymore because of central nervous toxicity.
Barclay 1994	Not a randomized trial. 890 babies in comparison between chlorhexidine and no specific treatment to cord.
Bhakoo 1969	Quasi-randomized trial but wrong intervention. Comparison between bathing and not bathing the baby. In both groups the umbilical stump was cleaned daily with savlon solution.
Birenbaum 1990	Randomized trial but wrong intervention. Comparison of gowning with no-gowning of visitors and hospital personnel to investigate effect on nose and umbilical colonization.
Bourke 1990	Not a randomized trial. All babies born in two designated wards were entered into study. Experimental group received no treatment and the control group was treated with alcohol (70%).
Bradshaw 1993	Randomized trial but combined intervention of alcohol and hexachlorophane. Hexachlorophene not recommended anymore because of central nervous toxicity.
Branchi 1998	Not a randomized trial. 346 babies in comparison between alcohol and salicylic sugar powder.
Coyer 1975	Abstract refers to a trial with 271 babies randomized to neosporin cord care compared with triple dye and no specific cord care. No publication arising from this trial, and no results available. Numbers of babies in the various arms incompatible with randomization.
Gezon 1964	Daily whole body bath with hexachlorophene during the hospital stay and three weeks at home was compared to daily bath with a detergent. Hexachlorophene not recommended because of central nervous toxicity.
Gluck 1963	Comparison between entire body wash with hexachlorophene, no wash and dry skin care. Hexachlorophene not recommended because of central nervous toxicity.
Henningsson 1981	Alternate allocation. Interventions were bathing or washing the baby. Outcomes were bacterial colonization, clinical infection, body temperature and crying.
Hnatko 1977	Whole body wash with hexachlorophene compared to three other antiseptic agents. Hexachlorophene not recommended because of central nervous toxicity. Allocation to groups was according to predetermined schedule.
Jellard 1957	Allocation of treatment group to one of three wards in a hospital. Triple dye versus nothing; all received surgical spirit.
Kwong 1973	Daily bath with hexachlorophene compared to bath with tap water. Hexachlorophene not recommended because of central nervous toxicity.

Characteristics of excluded studies (Continued)

Olowe 1980	Randomized trial on 58 babies with glucose-6-phosphate dehydrogenase deficiency. The effect of different dressing powders versus no dressing powder on the severity of neonatal jaundice.
Oxford 1991	The authors did not give details of cord care that could have influenced the separation time. Additional information is being sought.
Pildes 1973	Not a randomized trial.
Pyati 1977	Controlled trial in which multiple applications of povidone iodine were compared with a single application. None of the outcomes for inclusion into the review were reported.
Smales 1988	Not a randomized trial. Two hospitals with different regimens reversed after two months. Chlorhexidine detergent solution compared with iodine in surgical spirit. Outcomes: bacterial colonization and time of cord separation.
Thomas 1979	Not a randomized trial. Treatment and control groups allocated by ward. Interventions were chlorhexidine powder versus chlorhexidine zinc oxide powder and chlorhexidine bath. Outcomes were infection, cord separation, bacterial colonization, days to discharge, and number of times cord re-clamped.
Verber 1993	Not a randomized trial. Treatment and control groups allocated by ward. Cross-over trial comparing chlorhexidine with dry cord care.
Watkinson 1992	Not a randomized trial. 50 babies delivered by caesarean section. Comparison between alcohol and hexachlorophane with no antiseptic.
Wojciechowska 1989	Study completed but not analysed. No data available.

ADDITIONAL TABLES

Table 01. Different combinations of antiseptics and antibiotics used in included trial

Antimicrobial	Placebo	Triple dye	Silver	Povidone-iodine	Alcohol	Bacitracin	Neomycin	Chlorhexidine
Triple dye	X	X	X	X		X	X	X
Silver sulfadiazine	X	X		X		X	X	
Povidone-iodine		X	X		X	X		
Alcohol	X	X		X				X
Bacitracin		X	X	X				
Neomycin		X						
Chlorhexidine	X				X			
Mercurochrome					X			X
Salicylic sugar powder	X	X			X			
Zinc powder	X	X			X			
Green clay powder	X	X			X			
Katoxin powder	X	X			X			
Fuschine	X	X			X			
Hydrophobic gauze								X

Table 02. Outcomes

Study	Cord infection	Disseminated infect.	Death	Cord separation time	Bact. colonization	Mat. satisfaction
Arad 1981	Y	Y	N	Y	N	N
Bain 1994	Y	N	N	Y	N	N
Barrett 1979	N	N	N	N	Y	N
Dore 1998	Y	N	N	Y	N	Y
Gladstone 1988	Y	N	N	Y	Y	Y
Golombek 2002	Y	N	N	Y	N	N
Hsu 1999	Y	N	N	Y	N	N
Janssen 2002	Y	Y	N	N	Y	N
Meberg 1985	Y	Y	N	N	Y	N
Meberg 1990	Y	Y	N	Y	N	N
Medves 1997	N	N	N	Y	Y	N
Mugford 1986	N	N	N	Y	N	N
Panyavudhikrai 2002	Y	N	N	N	N	N
Perapoch 1993	Y	N	N	Y	Y	Y
Pezatti 2002	Y	Y	Y	Y	Y	N
Rosenfeld 1990	N	Y	N	N	Y	N
Rush 1986	N	N	N	N	Y	N
Schuman 1985	Y	N	N	Y	N	N
Speck 1977	Y	Y	N	N	N	N
Speck 1980	Y	N	N	N	Y	N
Wald 1977	N	N	N	N	Y	N

Bact - Bacterial; Mat - Maternal

Table 03. Mean cord separation times

Cord care	Study	N	Mean (days)	SD
None	Bain 1994	25	8.61	2.88
	Dore 1998	909	8.16	3.1
	Medves 1997	65	10.5	3.7
	Pezzati 2002	177	7.5	3.1
	COMBINED	1176	8.7	

Table 03. Mean cord separation times (*Continued*)

Cord care	Study	N	Mean (days)	SD
Powder	Arad 1981	34	6.4	1.75
	Bain 1994	24	7.3	2.09
	Mugford 1986	199	6.29	1.73
	Mugford 1986	202	6.93	1.95
	Mugford 1986	197	7.19	1.75
	Pezzati 2002	167	5.6	2.3
	COMBINED	789	6.63	
Alcohol	Panyavudhikrai 2002b	214	11.5	
	Bain 1994	24	8.96	3.51
	Dore 1998	907	9.8	4.6
	Perapoch 1993	75	8.4	2.6
	Medves 1997	71	13.1	5.7
	Pezzati 2002	178	16.9	7.5
	Schuman 1985	36	10.7	3.3
	COMBINED	1505	11.3	
Antibiotics	Arad 1981	26	12.0	4.1
	Gladstone 1988	48	11.8	4.8
	COMBINED	74	11.9	
Triple dye	Arad 1981	36	7.7	3.6
	Gladstone 1988	14	17.4	6.7
	Hsu 1999	76	16.9	4.4
	Pezzati 2002	195	11.6	6.6
	Schuman 1985	35	15.7	3.6
	Panyavudhikrai 2002b	213	13.6	
	COMBINED	569	13.8	
Silver sulfadiazene	Arad 1981	25	10.6	4.1
	Gladstone 1988	42	13.8	3.9
	COMBINED	67	12.2	

ANALYSES

Comparison 01. Antiseptic vs dry cord care/placebo

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Cord infection	9	2831	Relative Risk (Fixed) 95% CI	0.53 [0.25, 1.13]
02 Bacterial colonization - Staphylococcus aureus			Relative Risk (Fixed) 95% CI	Subtotals only
03 Bacterial colonization - Streptococci			Relative Risk (Fixed) 95% CI	Subtotals only
04 Bacterial colonization - E.coli			Relative Risk (Fixed) 95% CI	Subtotals only
05 Parental satisfaction			Relative Risk (Fixed) 95% CI	Subtotals only

Comparison 02. Antiseptic vs dry cord care/placebo [continuous data]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Time to cord separation			Weighted Mean Difference (Random) 95% CI	Subtotals only

Comparison 03. Antiseptic vs antibiotic

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Bacterial colonization - Staphylococcus aureus			Relative Risk (Fixed) 95% CI	Subtotals only

Comparison 04. Antiseptic vs antibiotic [continuous data]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Time to cord separation			Weighted Mean Difference (Random) 95% CI	Subtotals only

Comparison 05. Antiseptic vs antiseptic

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Cord infection			Relative Risk (Fixed) 95% CI	Subtotals only
02 Bacterial colonization - Staphylococcus aureus			Relative Risk (Fixed) 95% CI	Subtotals only
03 Bacterial colonization - Streptococci			Relative Risk (Fixed) 95% CI	Subtotals only
04 Bacterial colonization - E.coli			Relative Risk (Fixed) 95% CI	Subtotals only

Comparison 06. Antiseptic vs antiseptic [continuous data]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Time to cord separation			Weighted Mean Difference (Random) 95% CI	Subtotals only

Comparison 07. Single vs multiple applications [continuous data]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Time to cord separation			Weighted Mean Difference (Fixed) 95% CI	Subtotals only

Comparison 08. Washing cord vs dry cord care

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Bacterial colonization - Staphylococcus aureus			Relative Risk (Fixed) 95% CI	Subtotals only

Comparison 09. Antiseptic-aqueous based vs powder [Subgroup analysis]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Cord separation	3	1144	Weighted Mean Difference (Fixed) 95% CI	-4.76 [-5.34, -4.19]

Comparison 10. Antiseptic-alcohol based vs powder [Subgroup analysis]

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Cord separation	3	1093	Weighted Mean Difference (Fixed) 95% CI	-10.05 [-10.72, -9.38]

INDEX TERMS**Medical Subject Headings (MeSH)**

Anti-Bacterial Agents [*therapeutic use]; Anti-Infective Agents, Local [*therapeutic use]; *Delivery, Obstetric; Infant, Newborn; Sepsis [*prevention & control]; *Umbilical Cord

MeSH check words

Humans

COVER SHEET

Title	Topical umbilical cord care at birth
Authors	Zupan J, Garner P, Omari AAA
Contribution of author(s)	Jelka Zupan and Paul Garner extracted the data, analysed the data and wrote the first edition of the review. Aika Omari extracted and analysed the data for the second edition of the review which was checked by Jelka Zupan. Jelka Zupan and Aika Omari wrote the second edition of the review and Paul Garner advised on the final draft.
Issue protocol first published	1998/2
Review first published	1998/2
Date of most recent amendment	16 November 2004
Date of most recent SUBSTANTIVE amendment	06 May 2004

What's New	September 2003: Eleven new studies with 3773 participants were included, two from less developed countries (Taiwan and Thailand). All but two were published in 1990 or later. Two studies included preterm infants and one study reported deaths.
Date new studies sought but none found	Information not supplied by author
Date new studies found but not yet included/excluded	Information not supplied by author
Date new studies found and included/excluded	01 September 2003
Date authors' conclusions section amended	Information not supplied by author
Contact address	Dr Jelka Zupan Medical Officer Department of Reproductive Health World Health Organization 20 Avenue Appia 1211 Geneva 27 SWITZERLAND E-mail: zupanj@who.int Tel: +41 22 7914221 Fax: +41 22 7914189
DOI	10.1002/14651858.CD001057.pub2
Cochrane Library number	CD001057
Editorial group	Cochrane Pregnancy and Childbirth Group
Editorial group code	HM-PREG

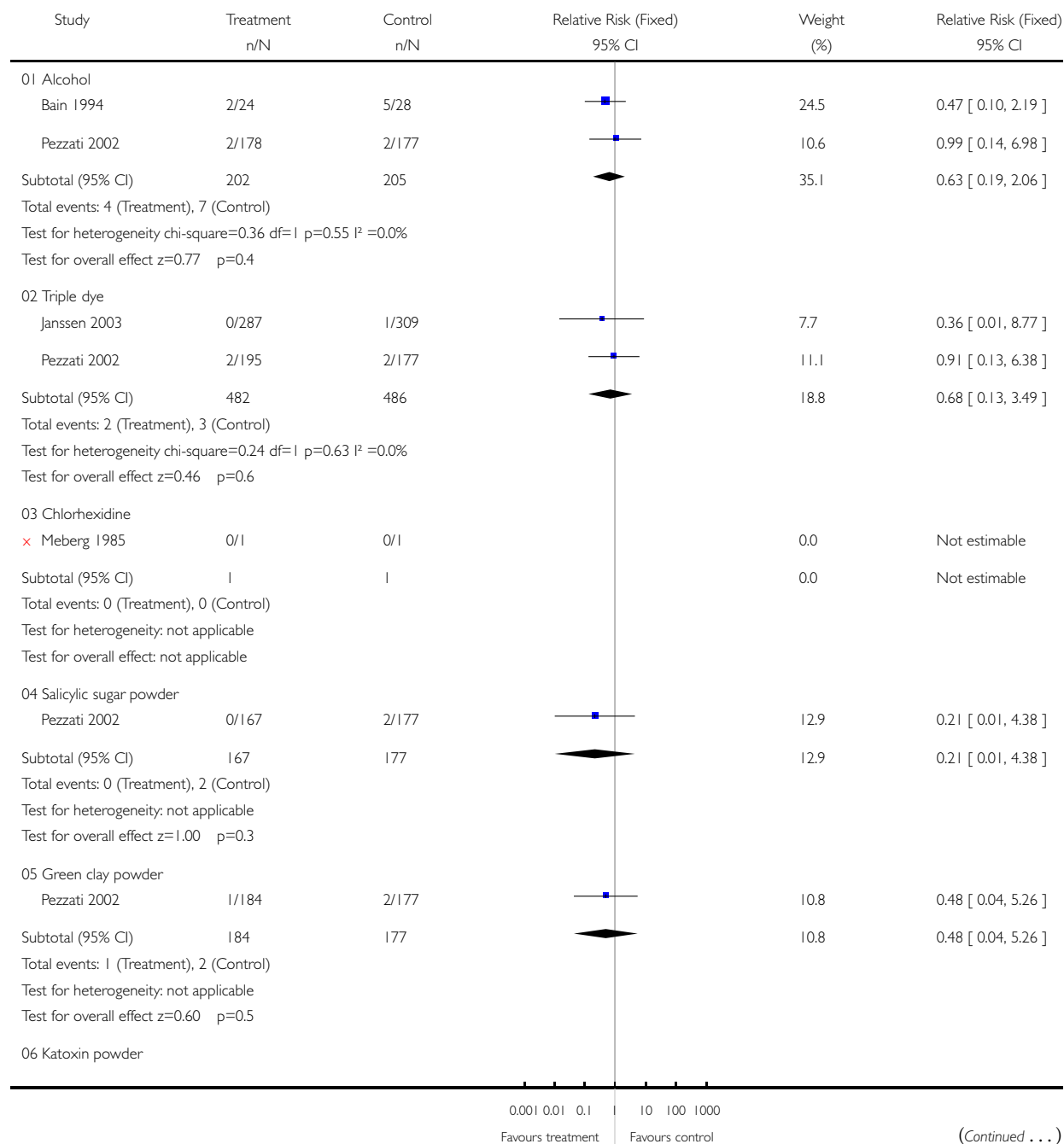
GRAPHS AND OTHER TABLES

Analysis 01.01. Comparison 01 Antiseptic vs dry cord care/placebo, Outcome 01 Cord infection

Review: Topical umbilical cord care at birth

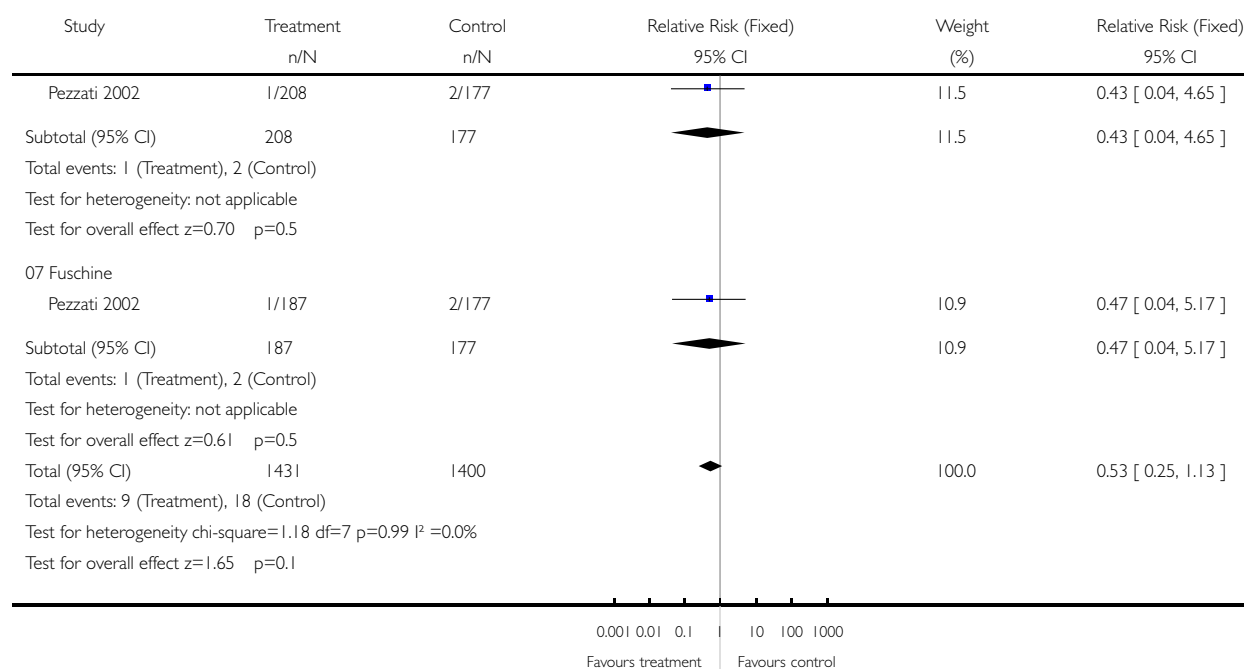
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Outcome: 01 Cord infection



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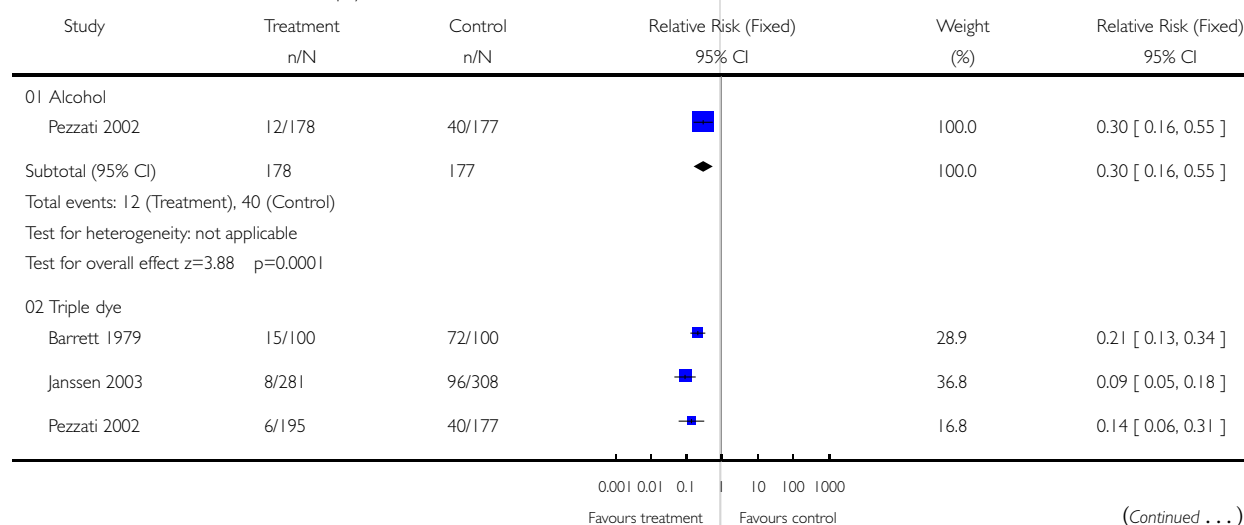


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Review: Topical umbilical cord care at birth

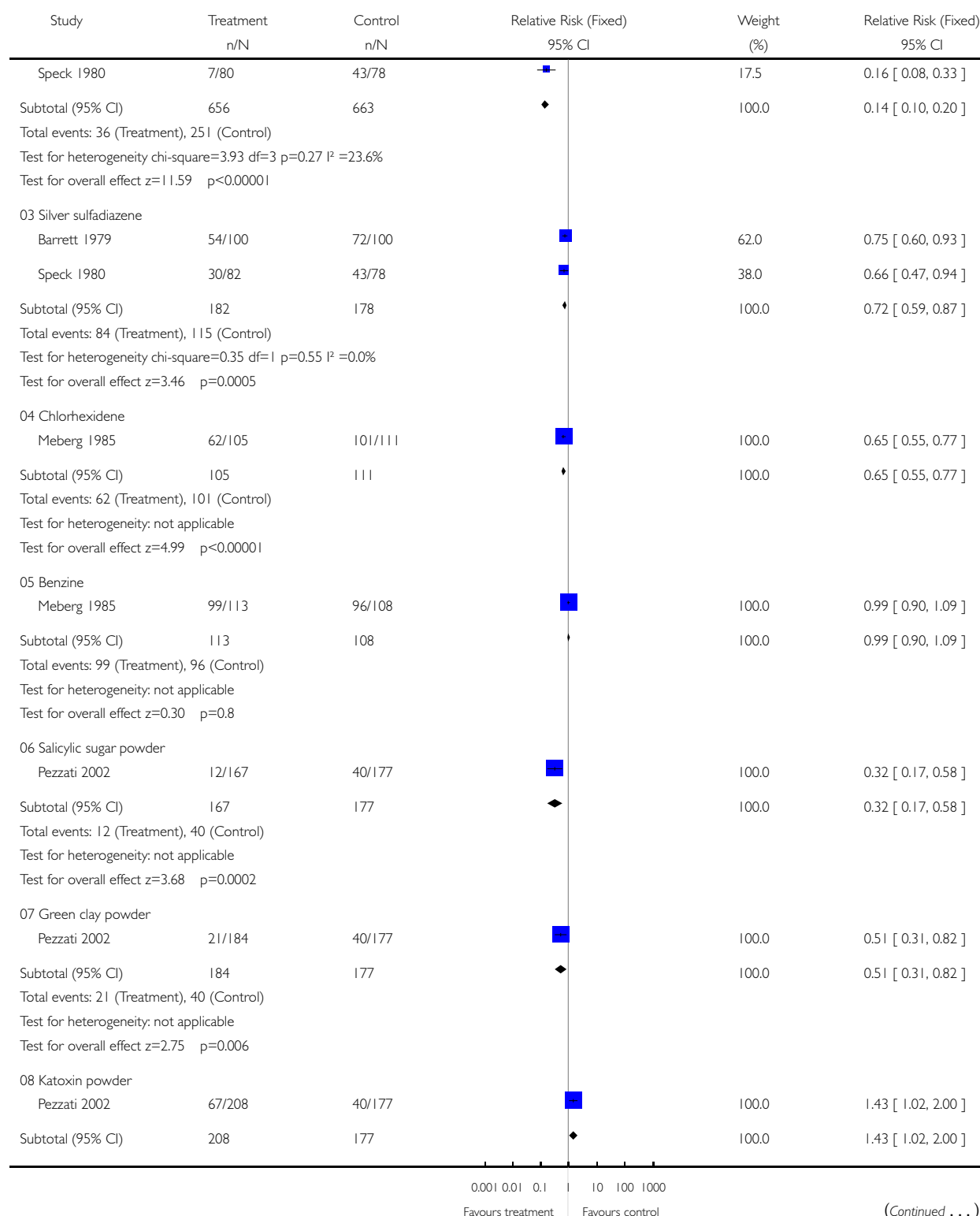
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Outcome: 02 Bacterial colonization - Staphylococcus aureus

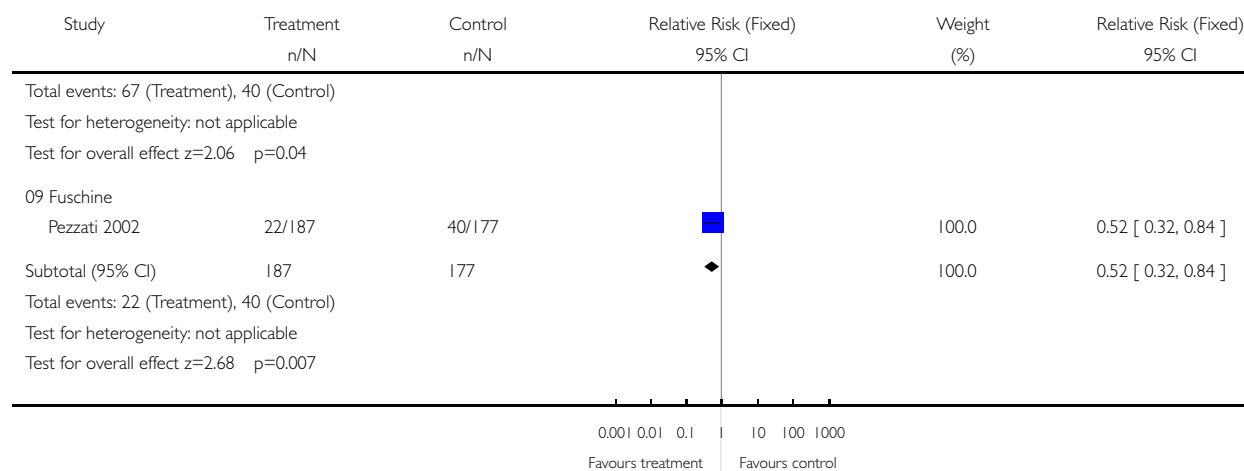


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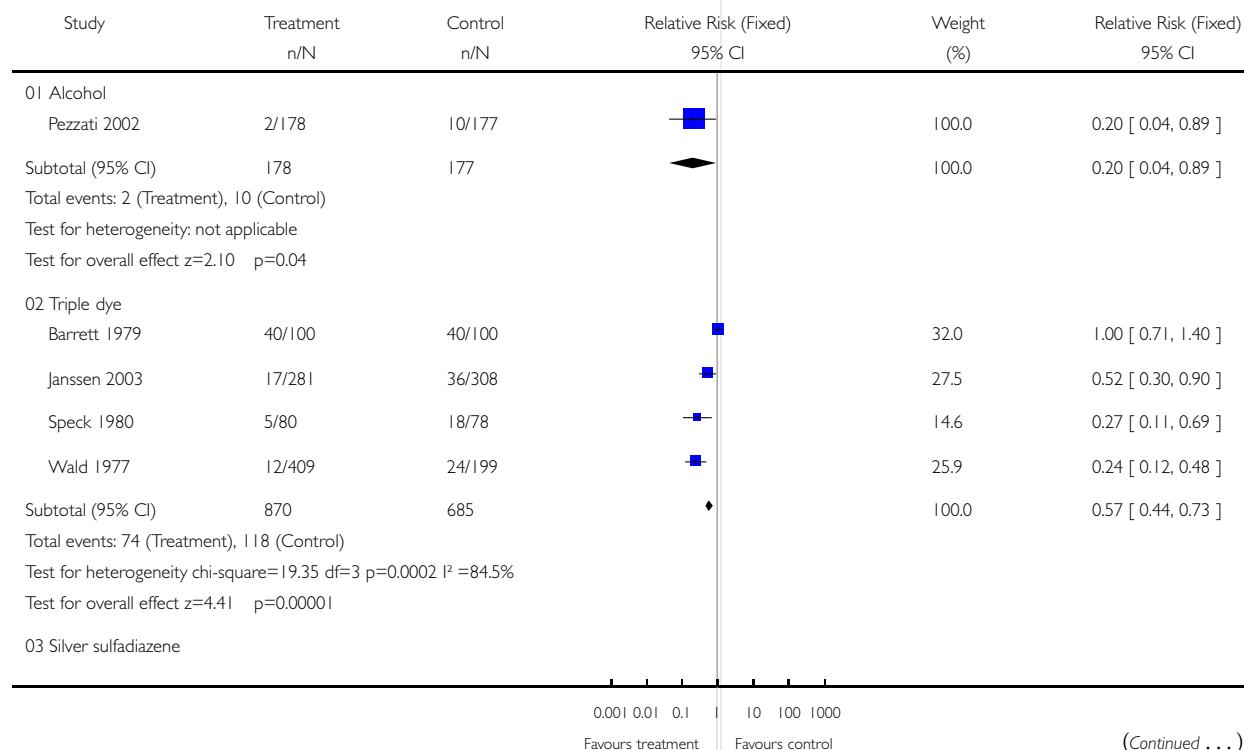


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Review: Topical umbilical cord care at birth

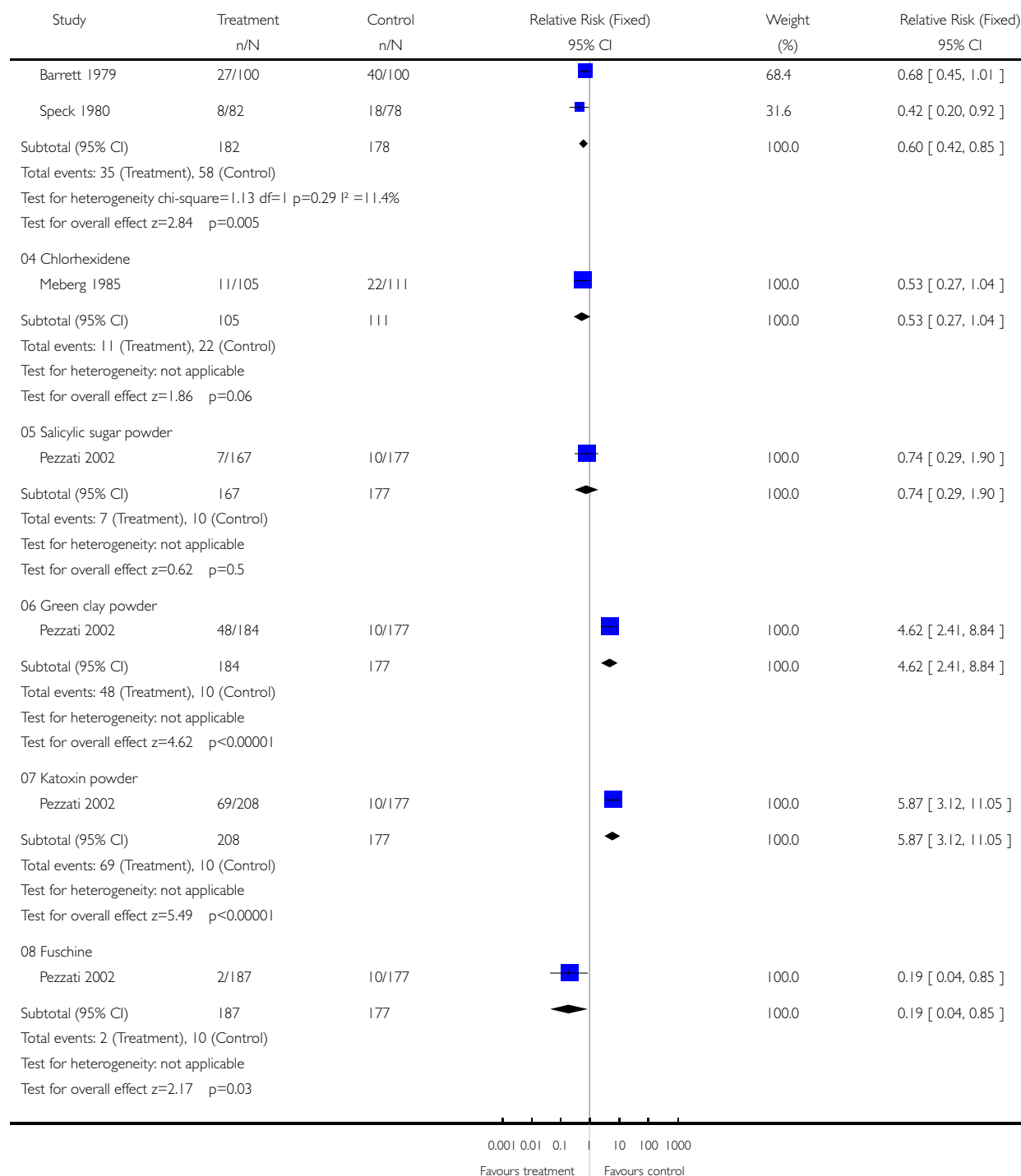
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Outcome: 03 Bacterial colonization - Streptococci



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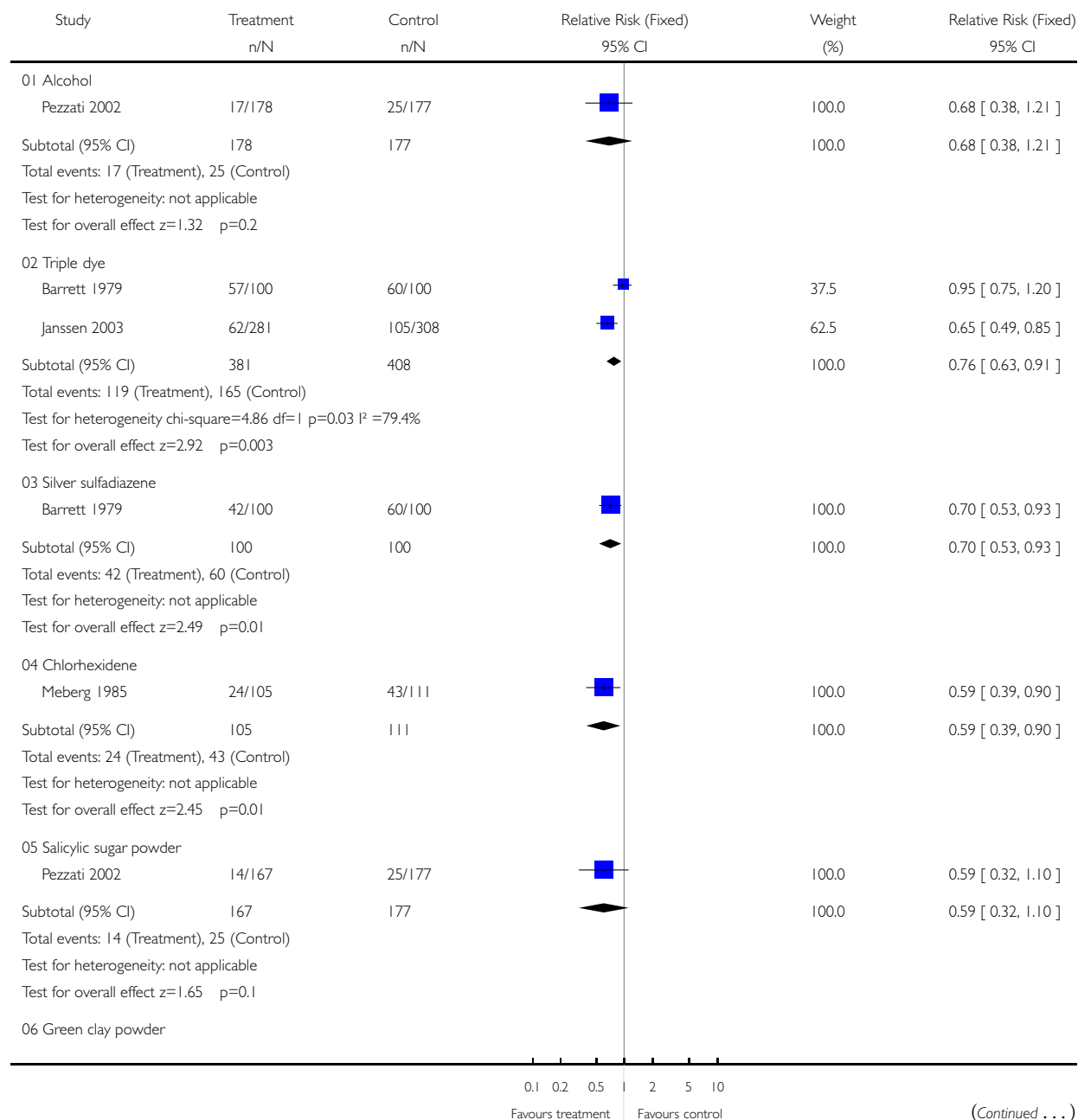


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Review: Topical umbilical cord care at birth

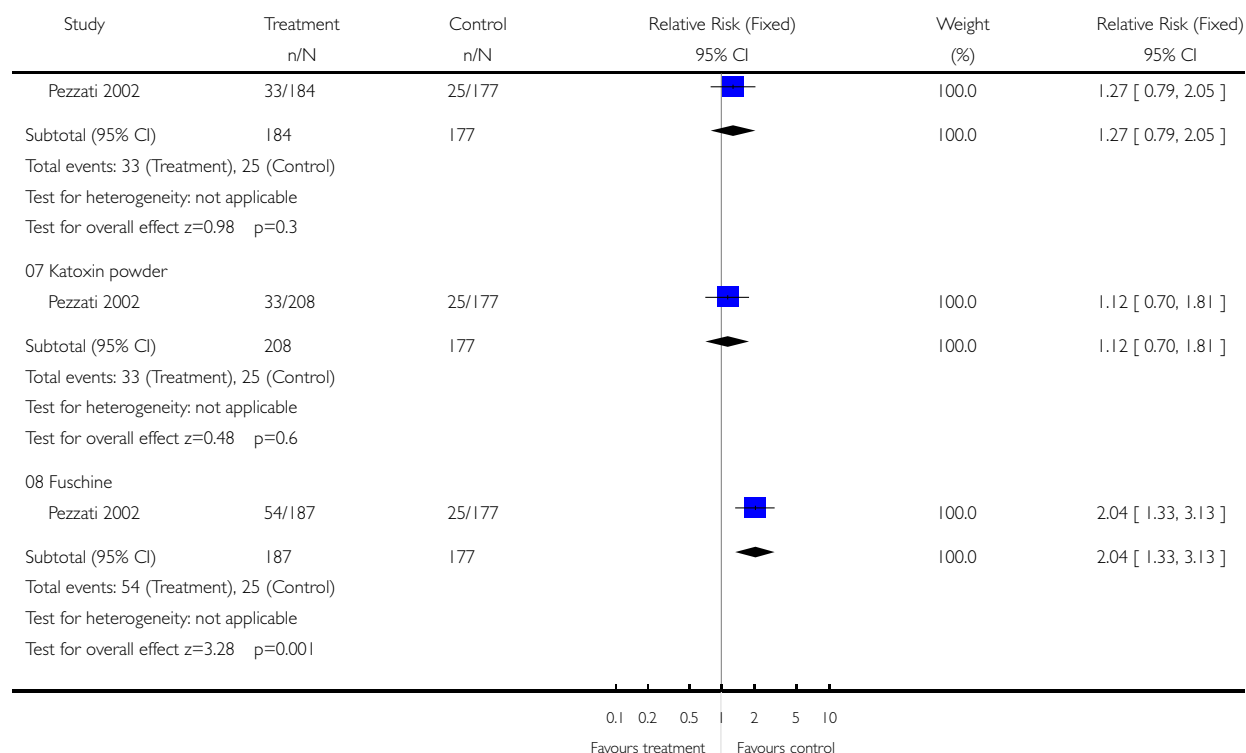
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Outcome: 04 Bacterial colonization - E.coli



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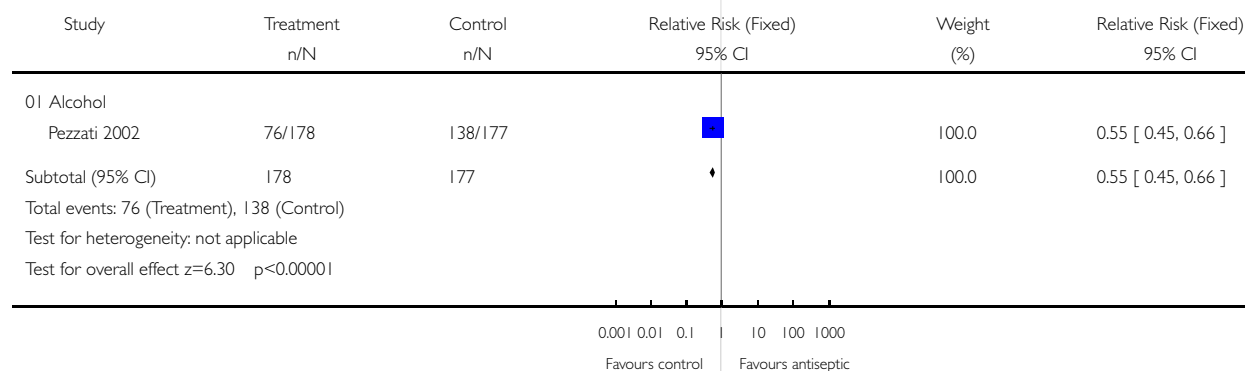


Analysis 01.05. Comparison 01 Antiseptic vs dry cord care/placebo, Outcome 05 Parental satisfaction

Review: Topical umbilical cord care at birth

Comparison: 01 Antiseptic vs dry cord care/placebo

Outcome: 05 Parental satisfaction

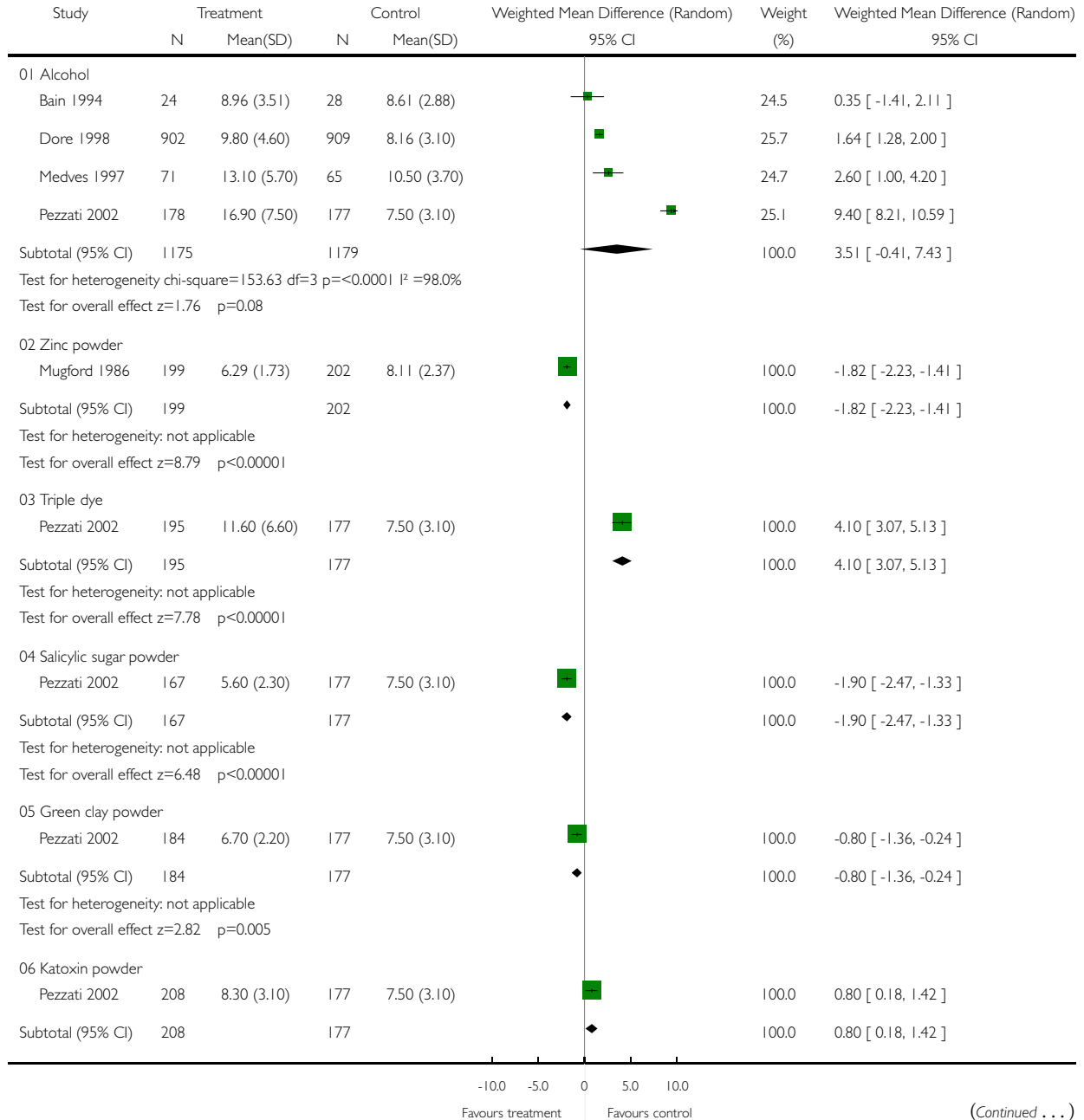


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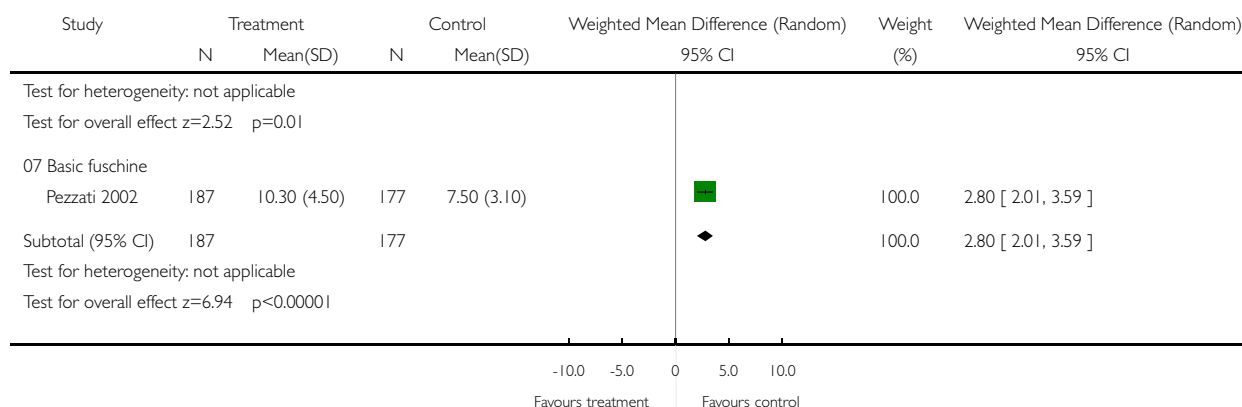
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Comparison: 02 Antiseptic vs dry cord care/placebo [continuous data]

Outcome: 01 Time to cord separation



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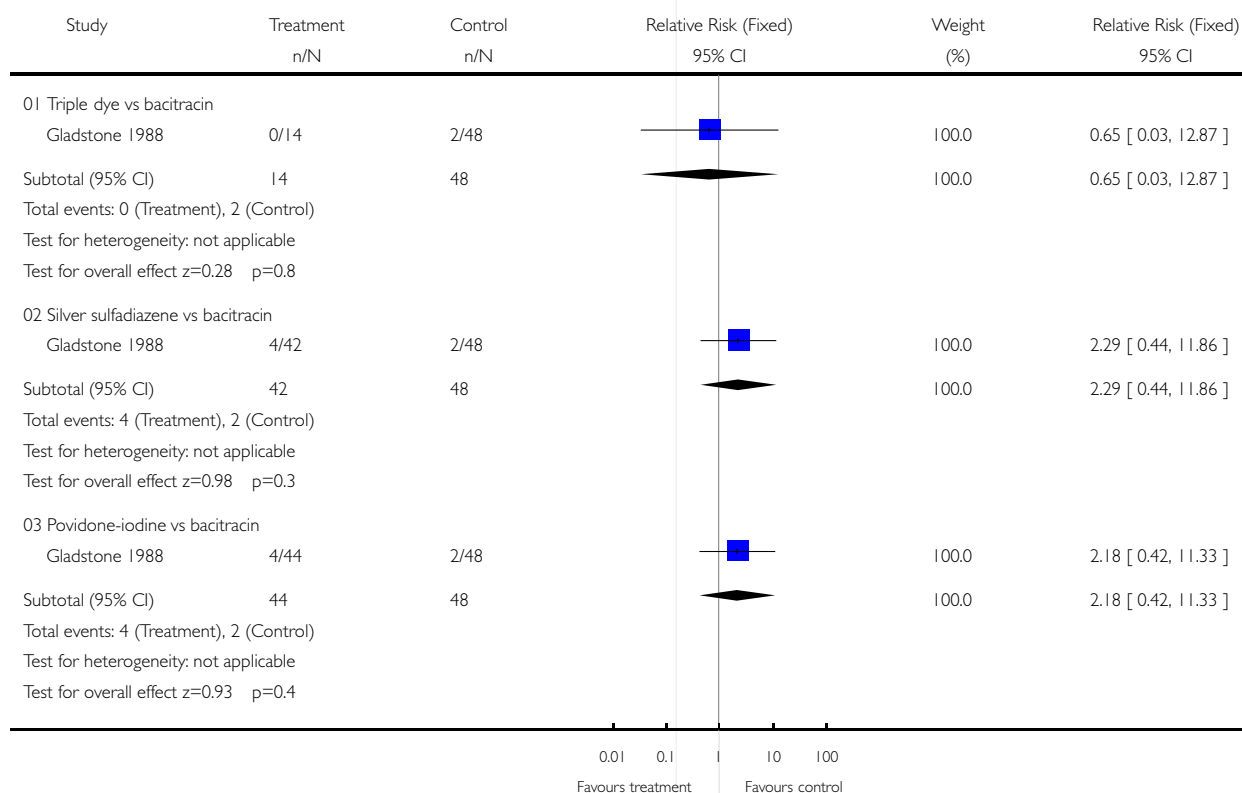


Analysis 03.01. Comparison 03 Antiseptic vs antibiotic, Outcome 01 Bacterial colonization - Staphylococcus aureus

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Comparison: 03 Antiseptic vs antibiotic

Outcome: 01 Bacterial colonization - Staphylococcus aureus

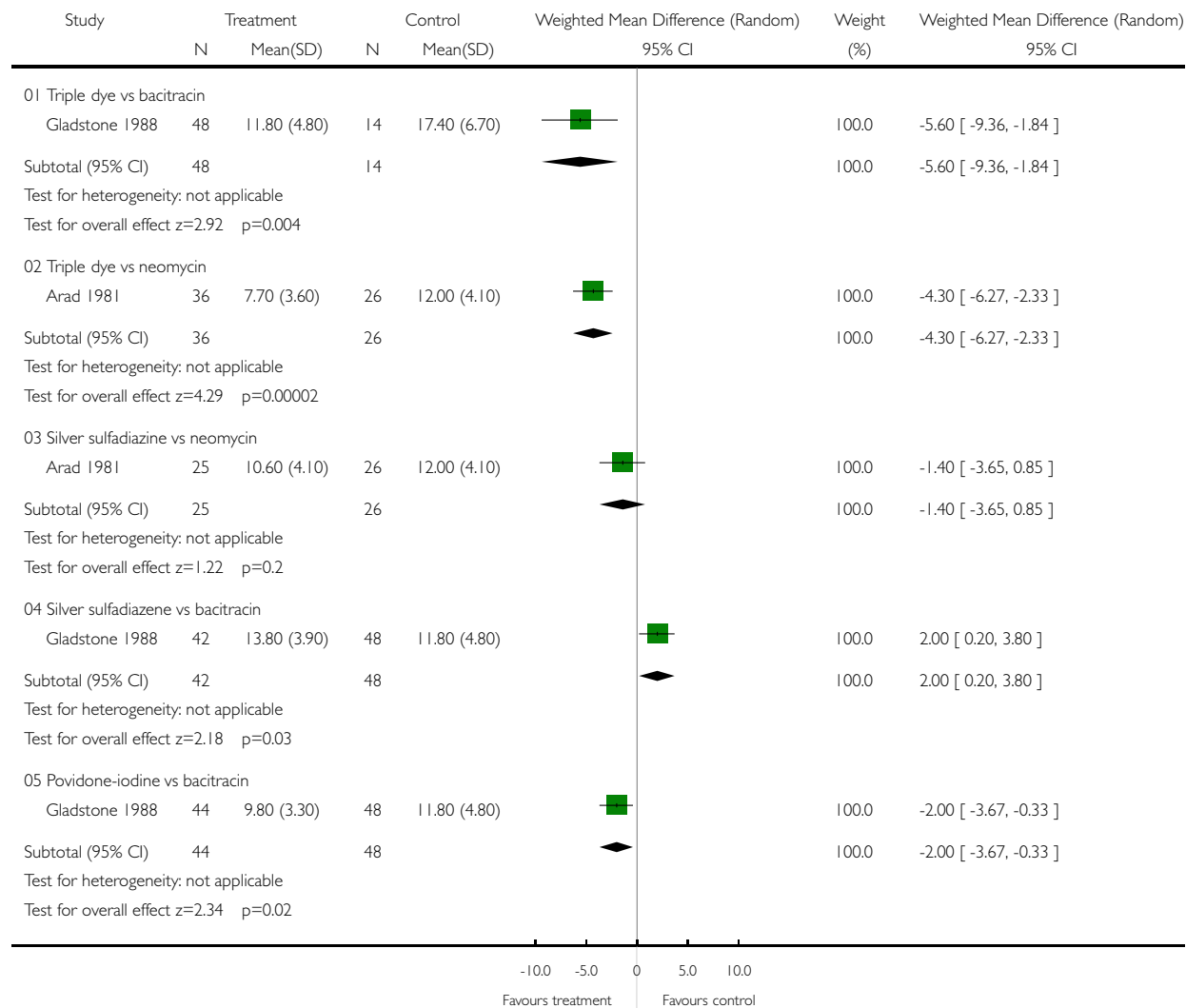


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Review: Topical umbilical cord care at birth

Comparison: 04 Antiseptic vs antibiotic [continuous data]

Outcome: 01 Time to cord separation

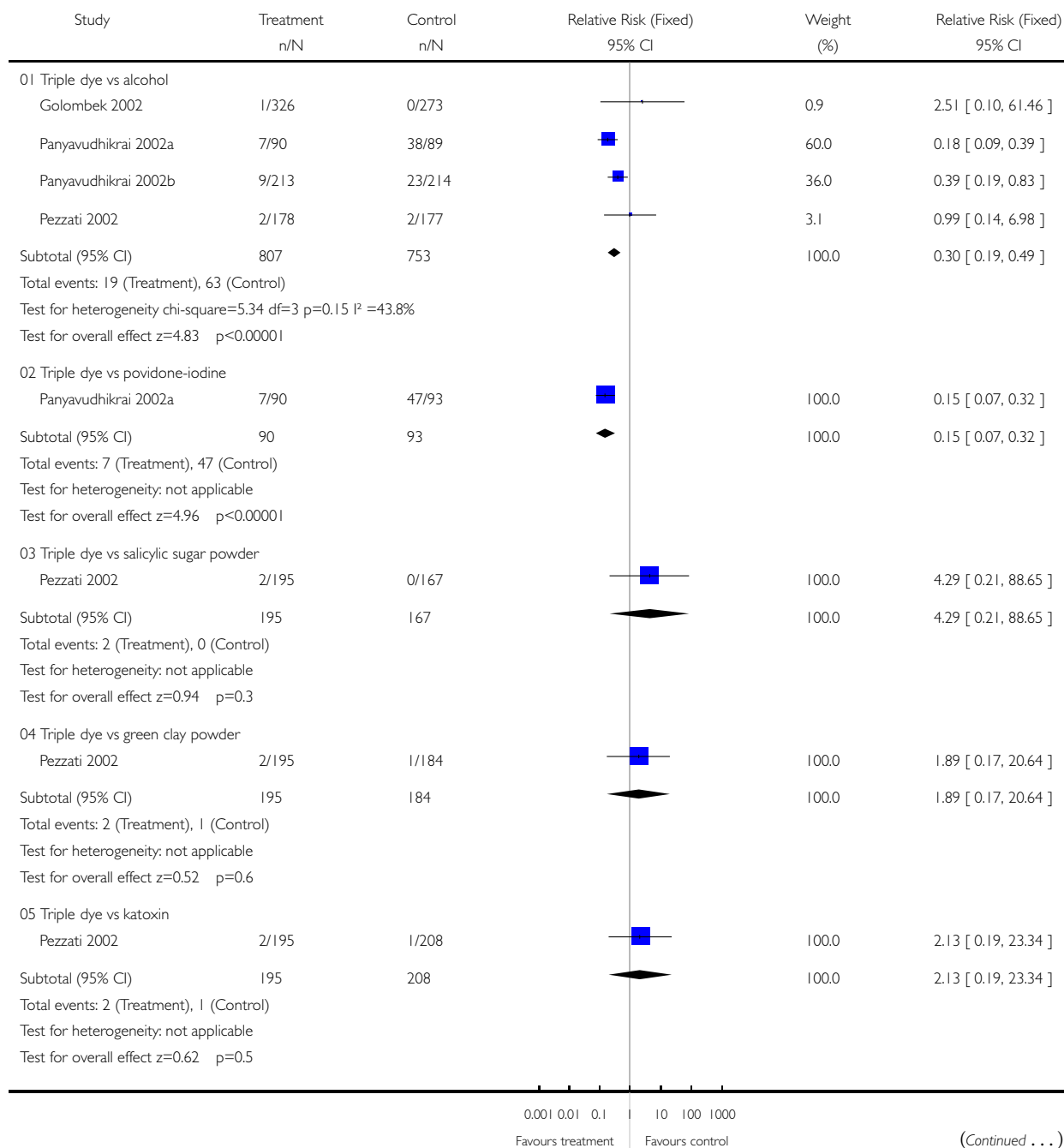


Analysis 05.01. Comparison 05 Antiseptic vs antiseptic, Outcome 01 Cord infection

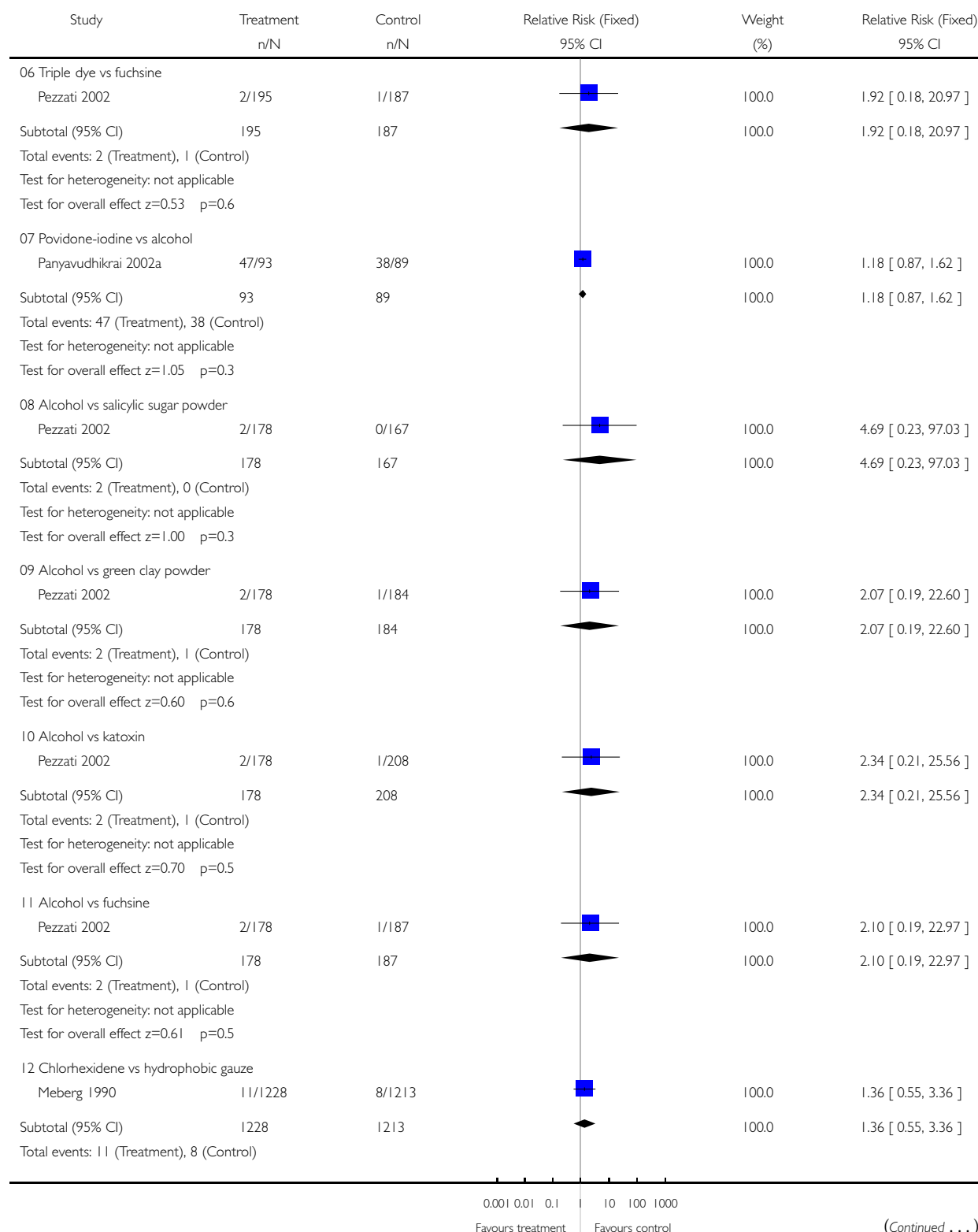
Review: Topical umbilical cord care at birth

Comparison: 05 Antiseptic vs antiseptic

Outcome: 01 Cord infection

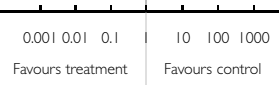


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










Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Test for heterogeneity: not applicable					
Test for overall effect $z=0.66$ $p=0.5$					
					

Analysis 05.02. Comparison 05 Antiseptic vs antiseptic, Outcome 02 Bacterial colonization - Staphylococcus aureus

Review: Topical umbilical cord care at birth

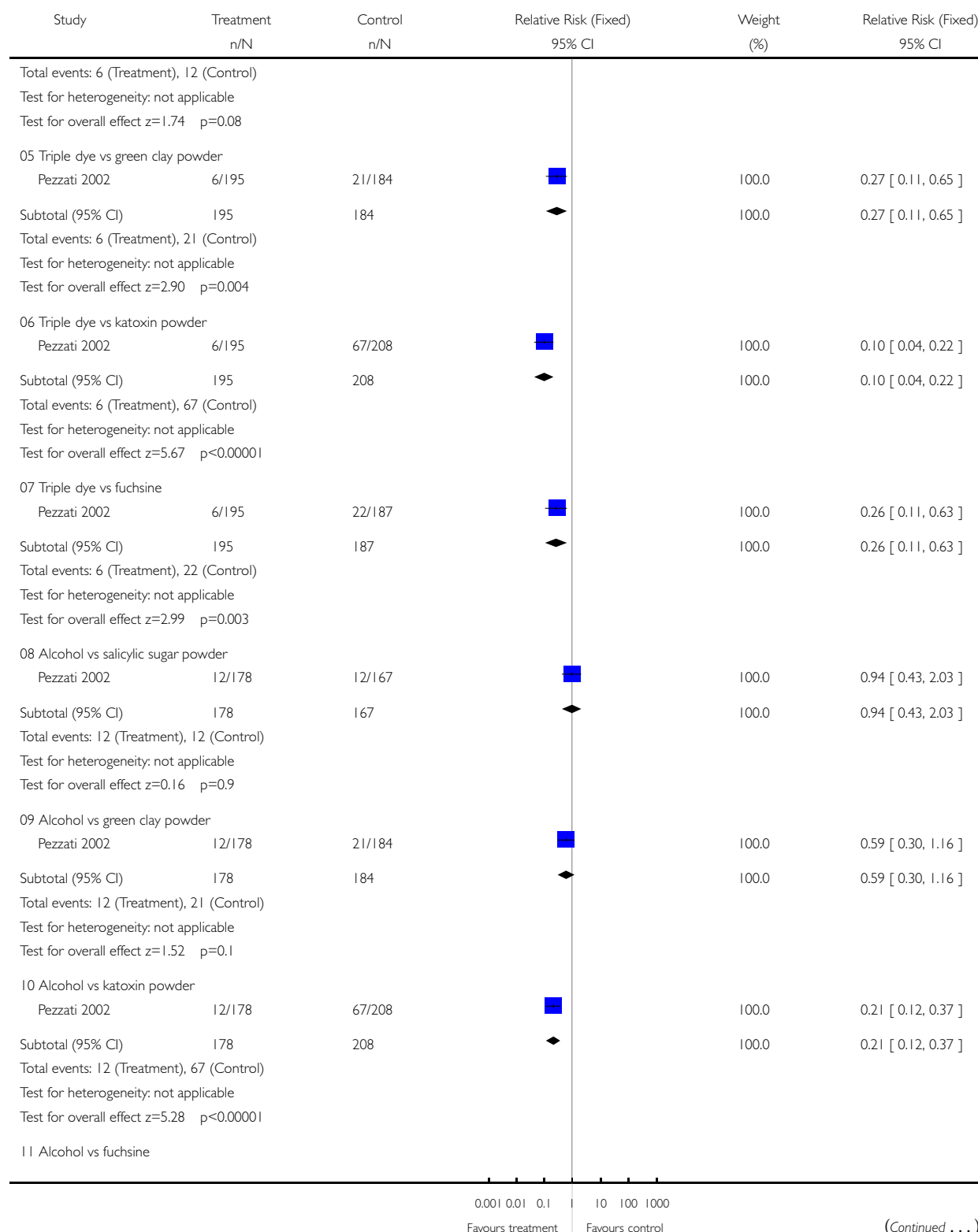
Comparison: 05 Antiseptic vs antiseptic

Outcome: 02 Bacterial colonization - Staphylococcus aureus

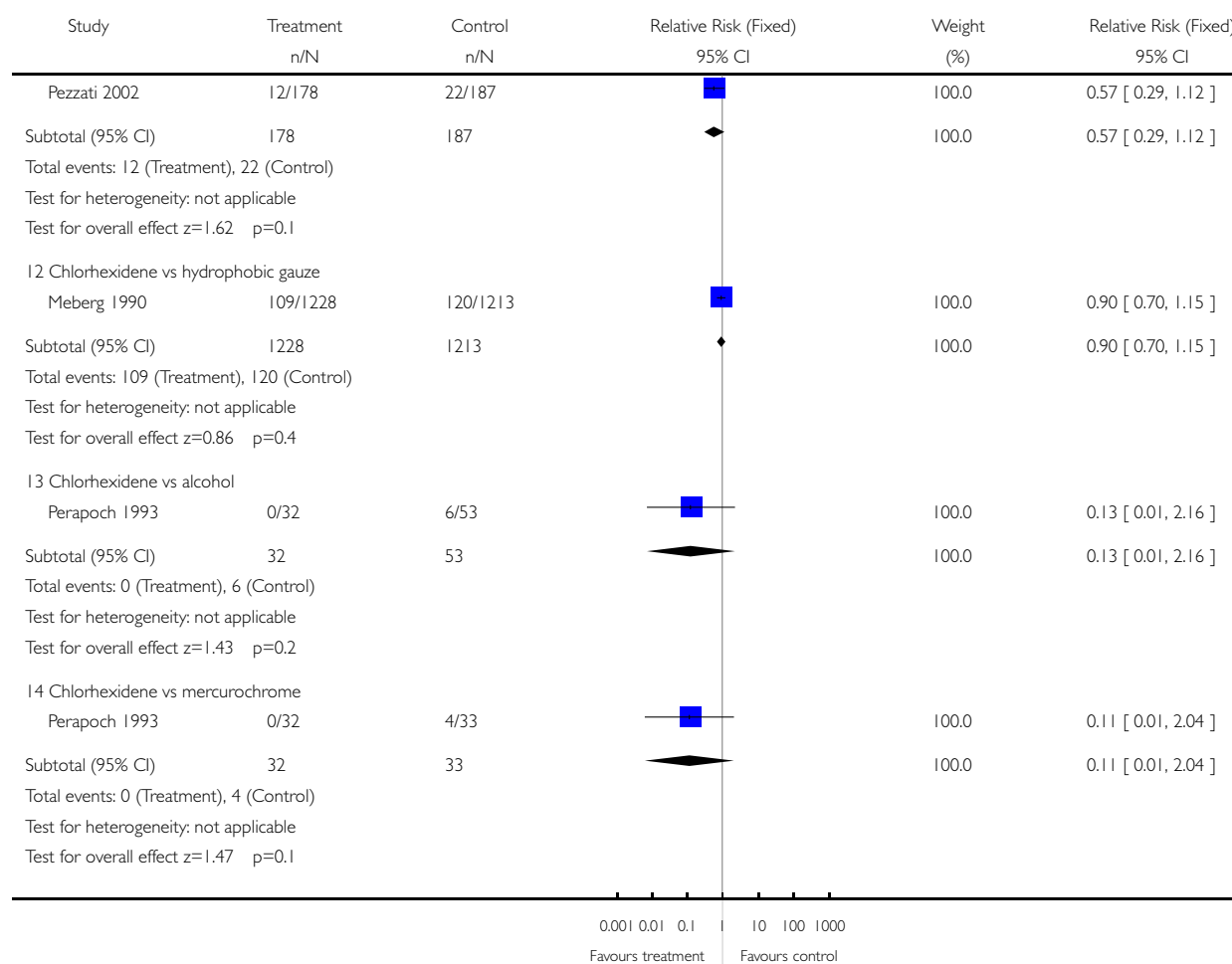
Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Triple dye vs alcohol					
Pezzati 2002	6/195	12/178		39.8	0.46 [0.17, 1.19]
Rosenfeld 1990	8/54	20/60		60.2	0.44 [0.21, 0.92]
Subtotal (95% CI)	249	238		100.0	0.45 [0.25, 0.81]
Total events: 14 (Treatment), 32 (Control)					
Test for heterogeneity $\chi^2=0.00$ $df=1$ $p=0.97$ $I^2=0.0\%$					
Test for overall effect $z=2.69$ $p=0.007$					
02 Triple dye vs silver sulfadiazene					
Barrett 1979	15/100	54/100		96.0	0.28 [0.17, 0.46]
Gladstone 1988	0/14	4/44		4.0	0.33 [0.02, 5.84]
Subtotal (95% CI)	114	144		100.0	0.28 [0.17, 0.46]
Total events: 15 (Treatment), 58 (Control)					
Test for heterogeneity $\chi^2=0.02$ $df=1$ $p=0.90$ $I^2=0.0\%$					
Test for overall effect $z=5.05$ $p<0.00001$					
03 Triple dye vs povidone-iodine					
Gladstone 1988	0/14	2/48		100.0	0.65 [0.03, 12.87]
Subtotal (95% CI)	14	48		100.0	0.65 [0.03, 12.87]
Total events: 0 (Treatment), 2 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect $z=0.28$ $p=0.8$					
04 Triple dye vs salicylic sugar powder					
Pezzati 2002	6/195	12/167		100.0	0.43 [0.16, 1.12]
Subtotal (95% CI)	195	167		100.0	0.43 [0.16, 1.12]
					

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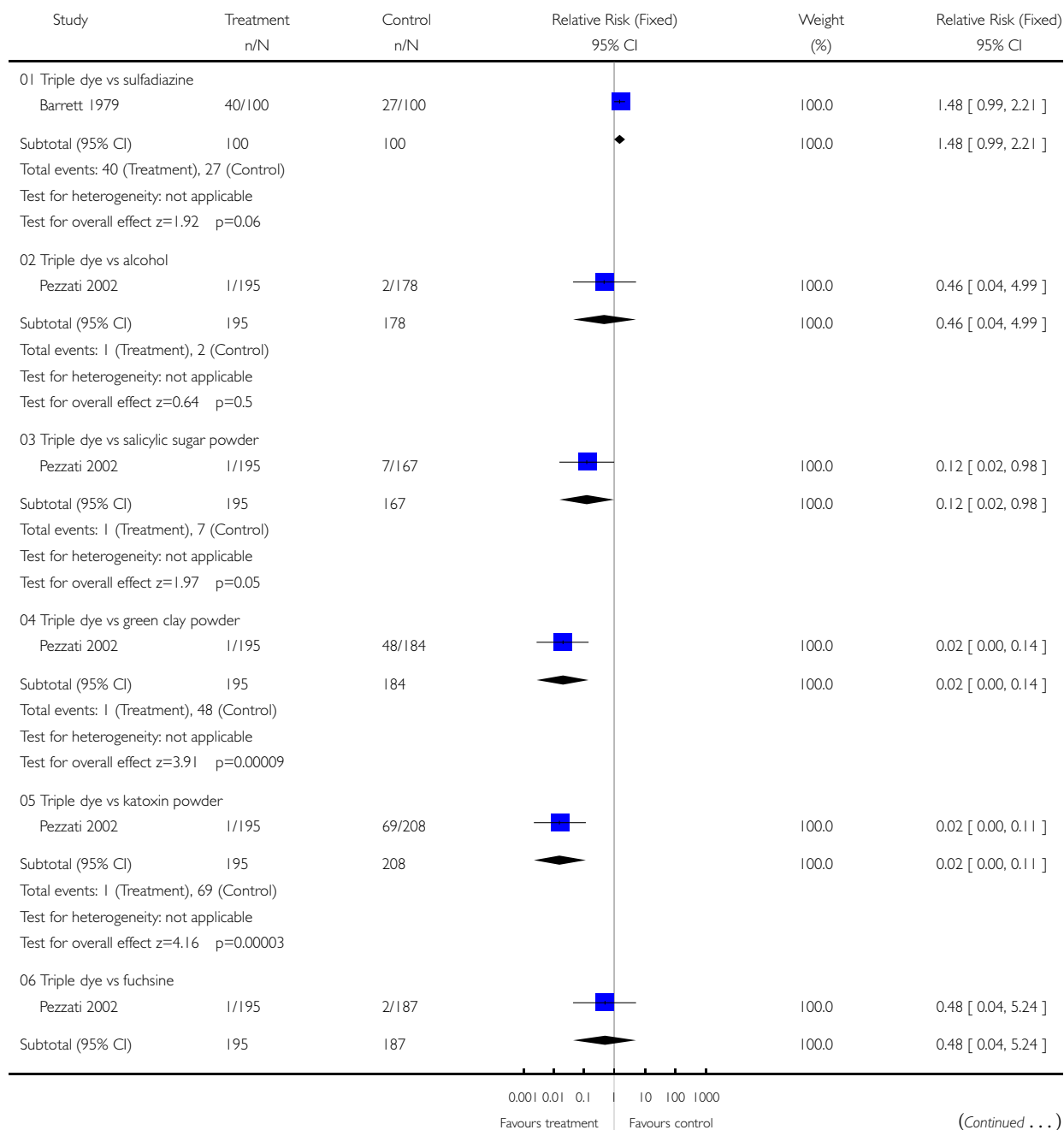


Analysis 05.03. Comparison 05 Antiseptic vs antiseptic, Outcome 03 Bacterial colonization - Streptococci

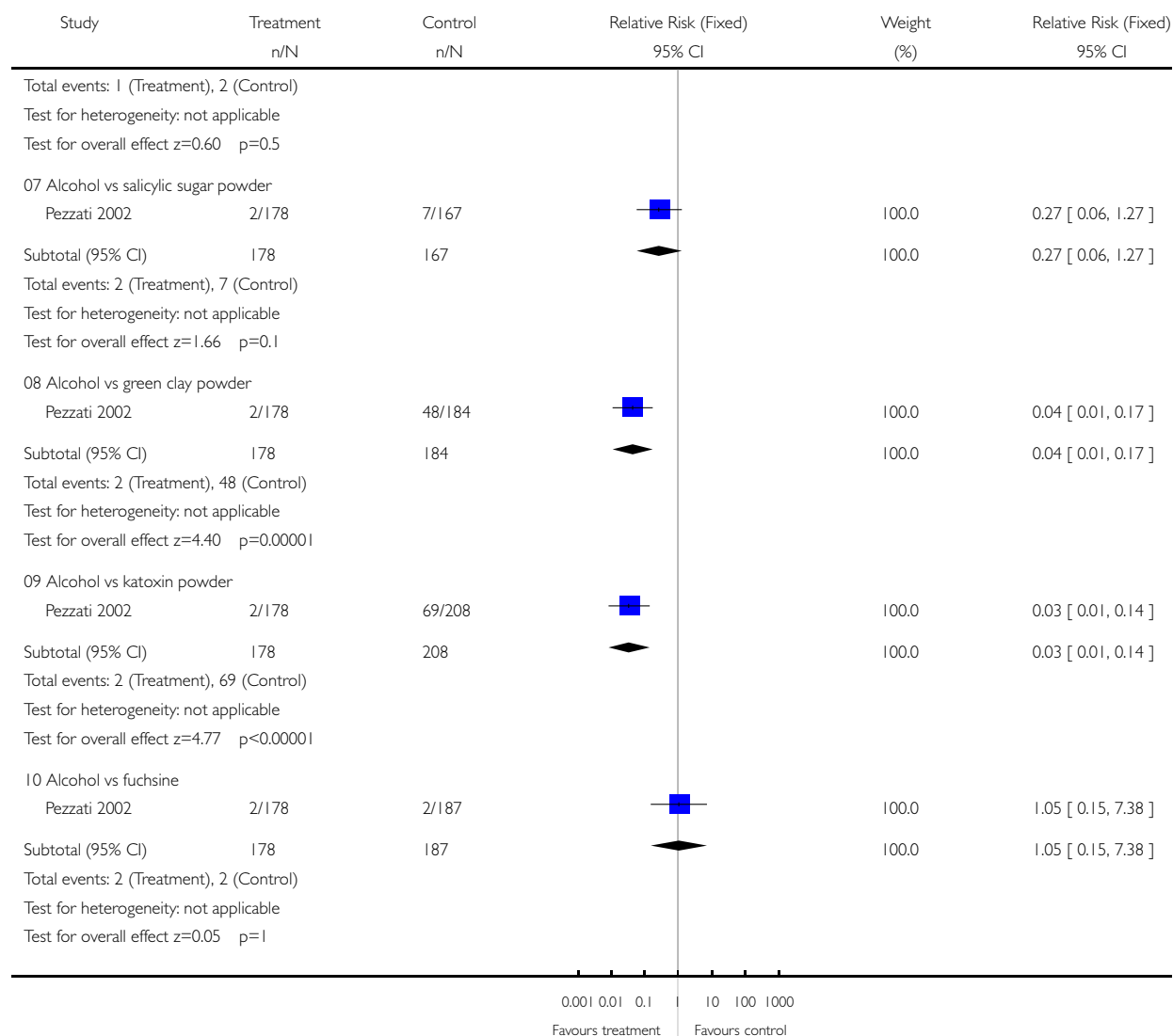
Review: Topical umbilical cord care at birth

Comparison: 05 Antiseptic vs antiseptic

Outcome: 03 Bacterial colonization - Streptococci



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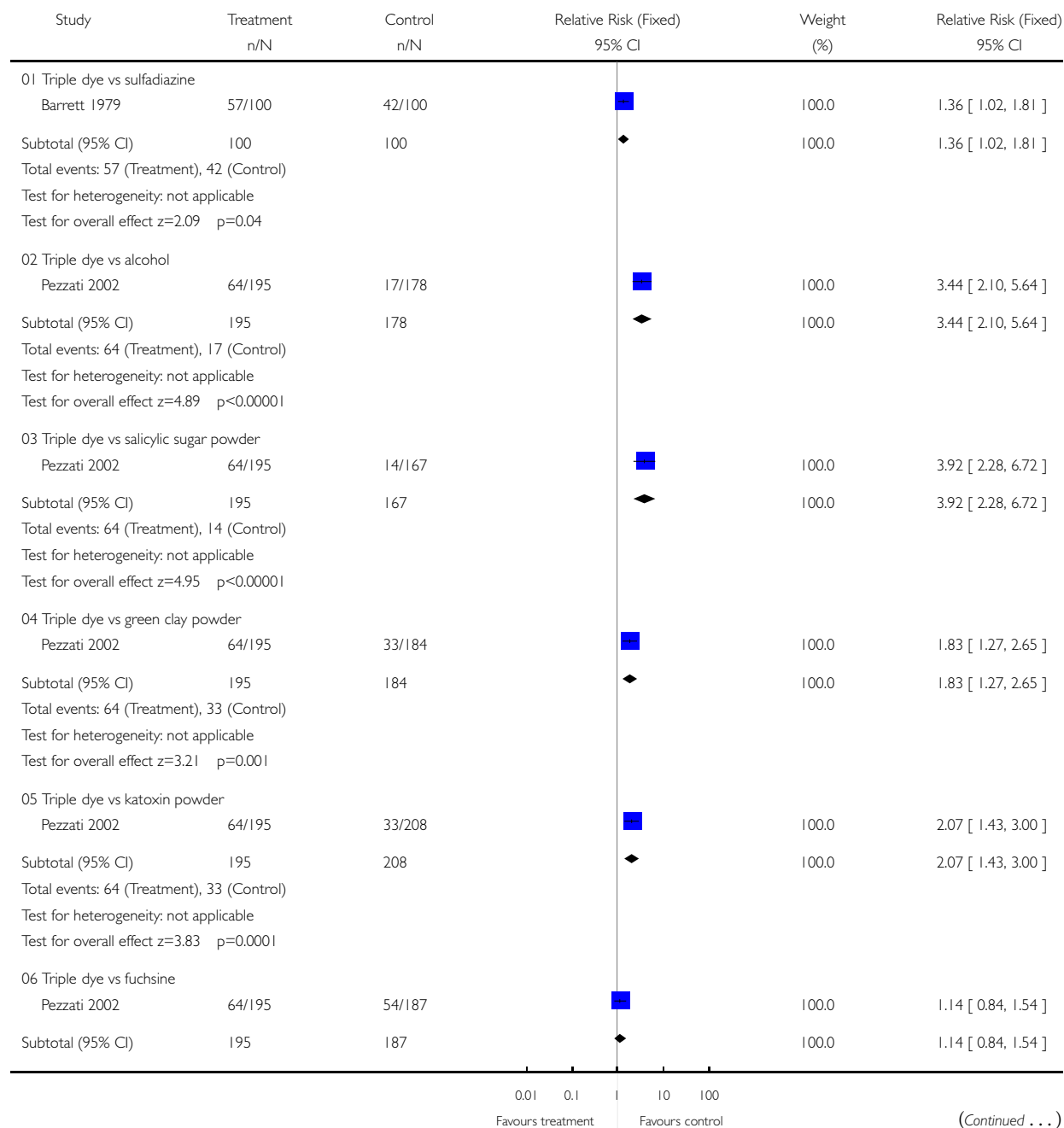


Analysis 05.04. Comparison 05 Antiseptic vs antiseptic, Outcome 04 Bacterial colonization - E.coli

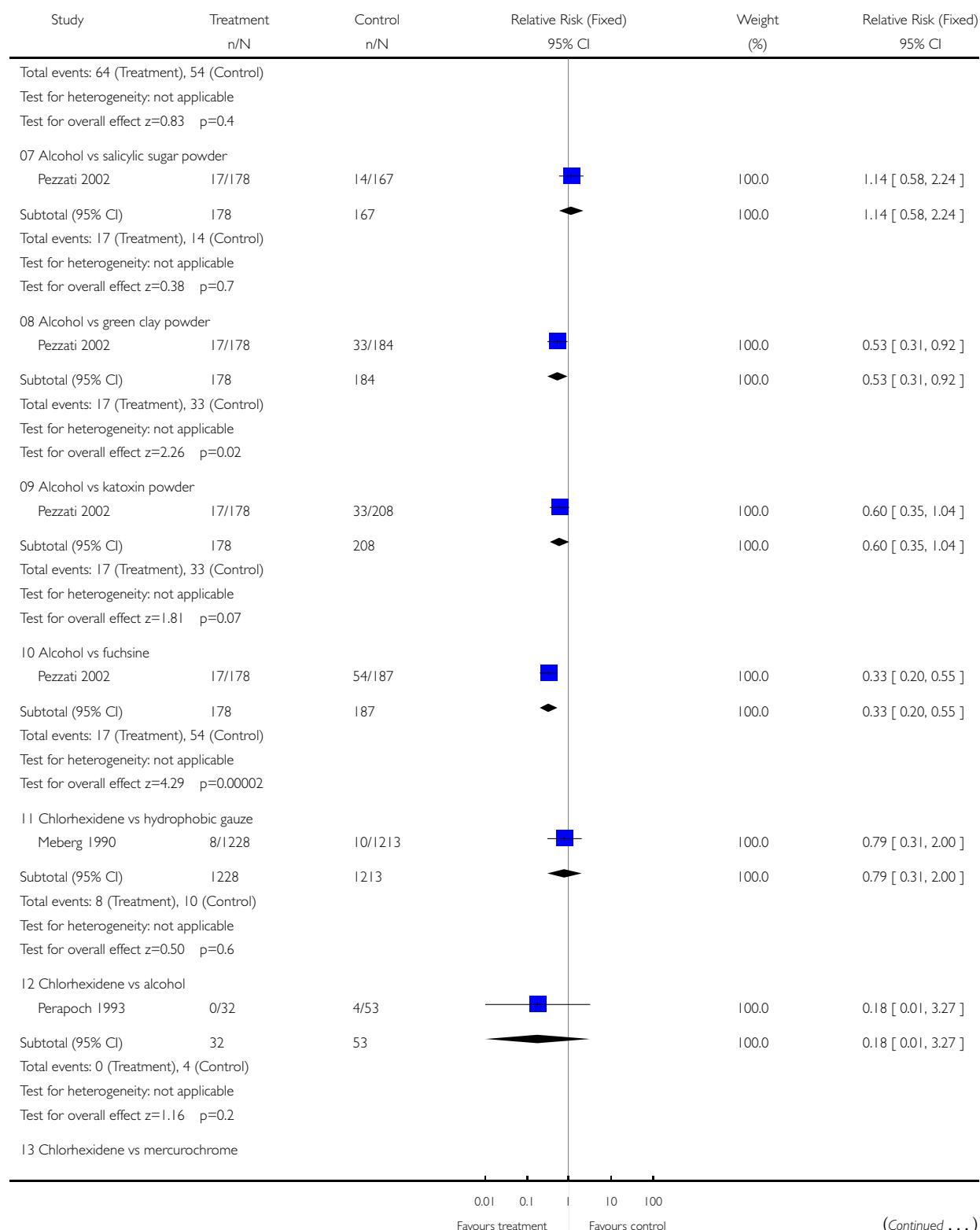
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Comparison: 05 Antiseptic vs antiseptic

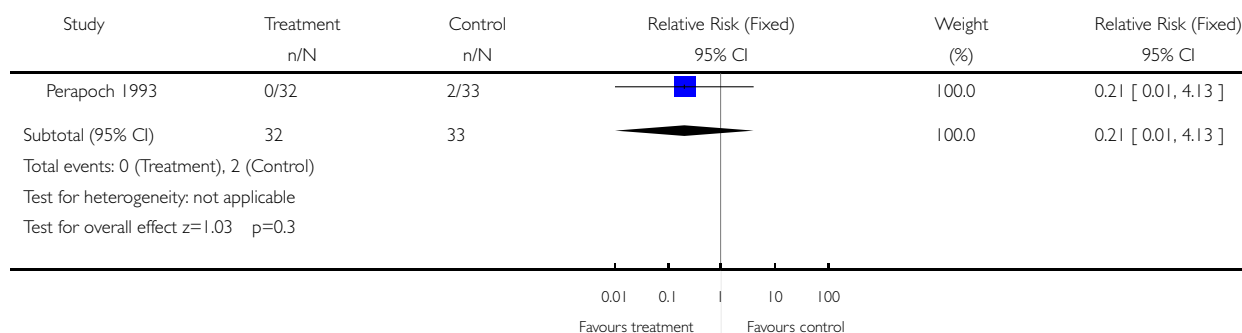
Outcome: 04 Bacterial colonization - E.coli



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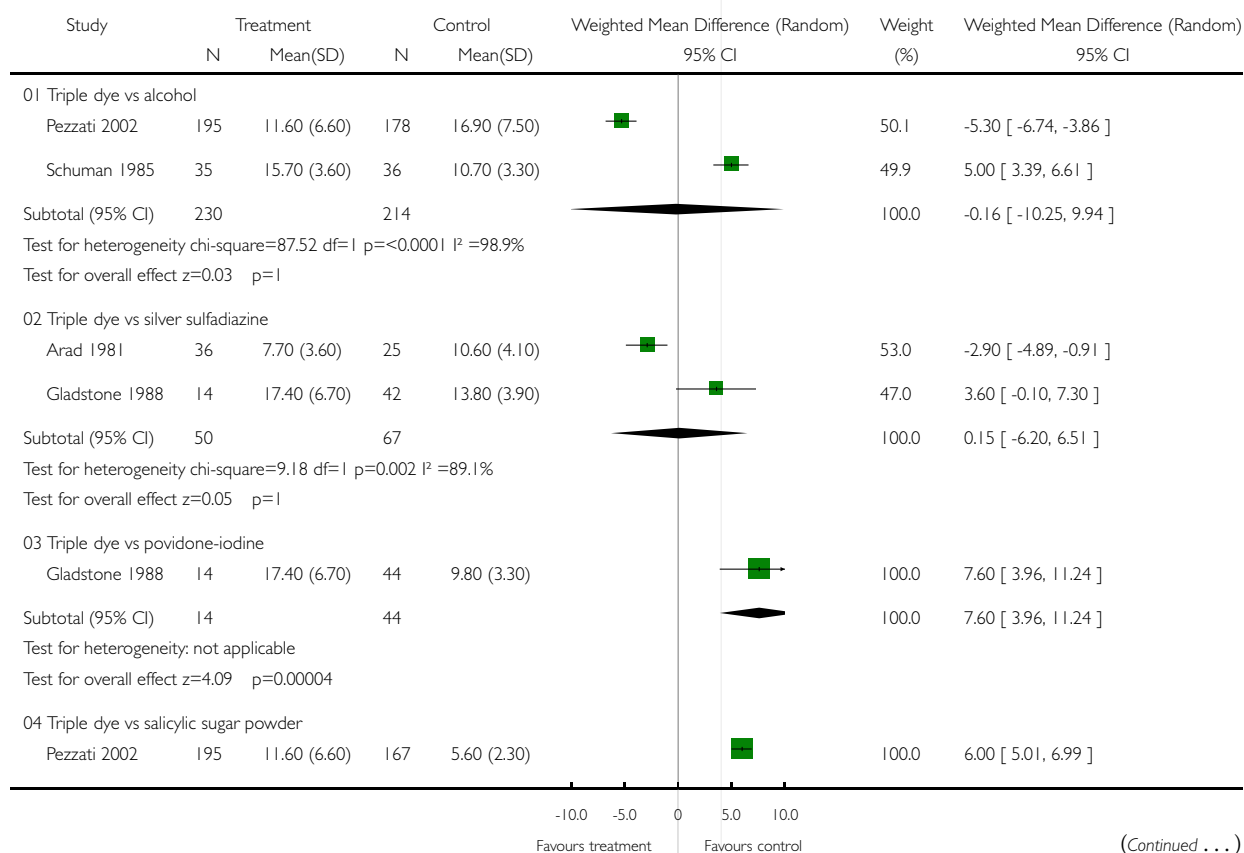


Analysis 06.01. Comparison 06 Antiseptic vs antiseptic [continuous data], Outcome 01 Time to cord separation

Review: Topical umbilical cord care at birth

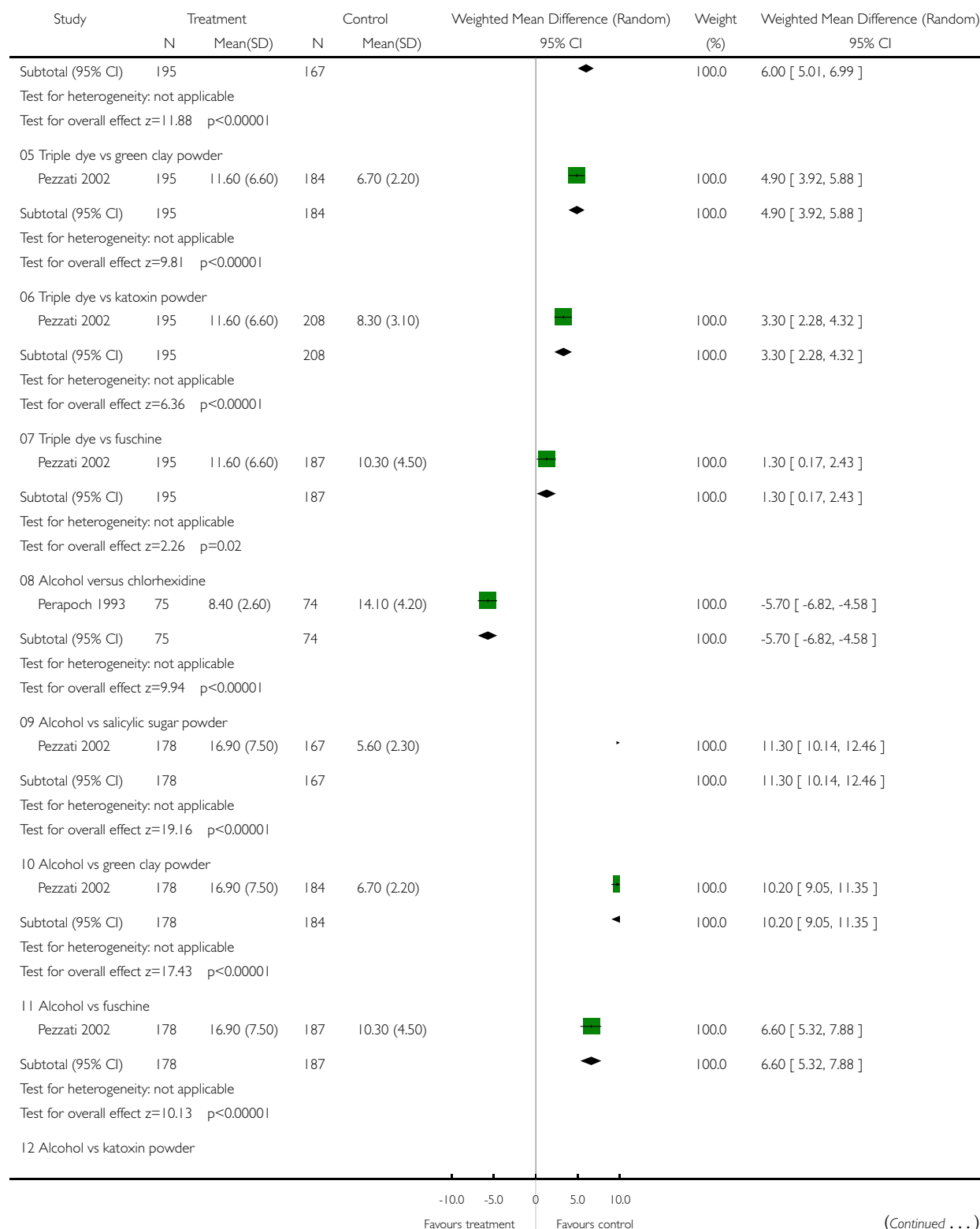
Comparison: 06 Antiseptic vs antiseptic [continuous data]

Outcome: 01 Time to cord separation



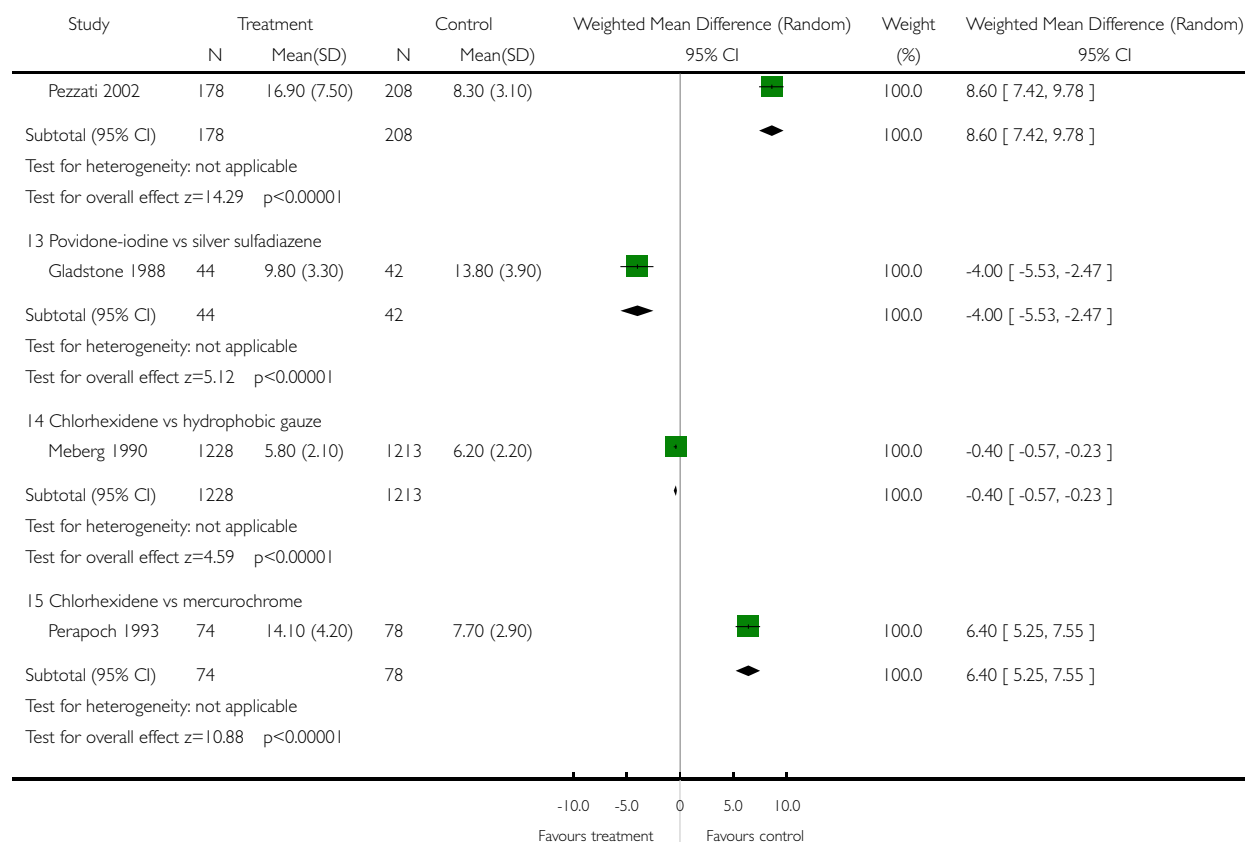
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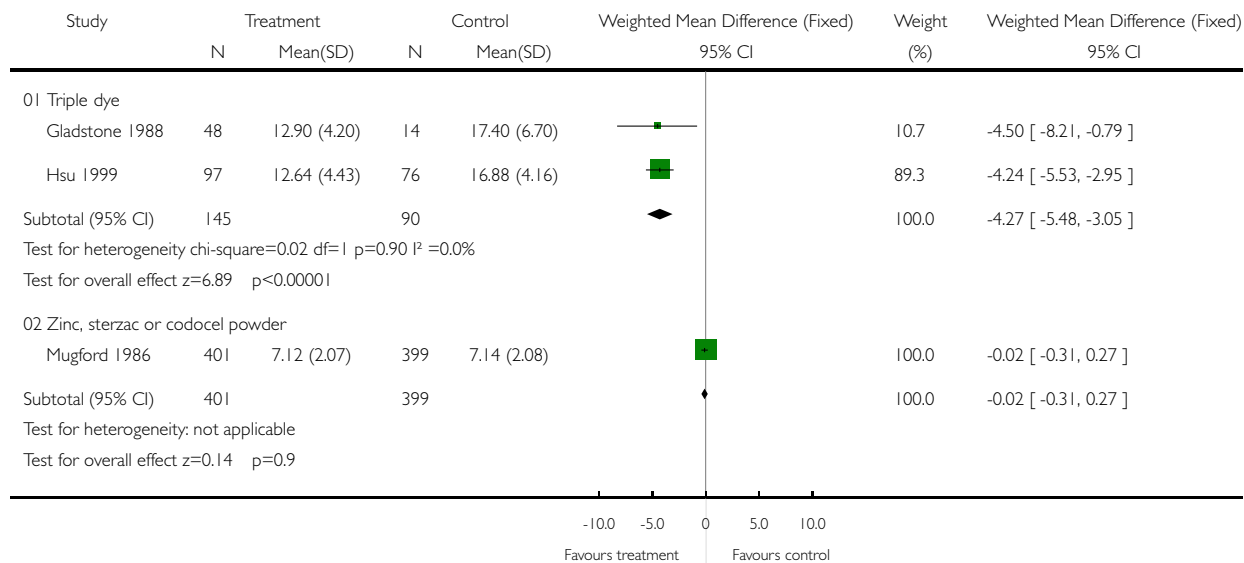


Analysis 07.01. Comparison 07 Single vs multiple applications [continuous data], Outcome 01 Time to cord separation

Review: Topical umbilical cord care at birth

Comparison: 07 Single vs multiple applications [continuous data]

Outcome: 01 Time to cord separation

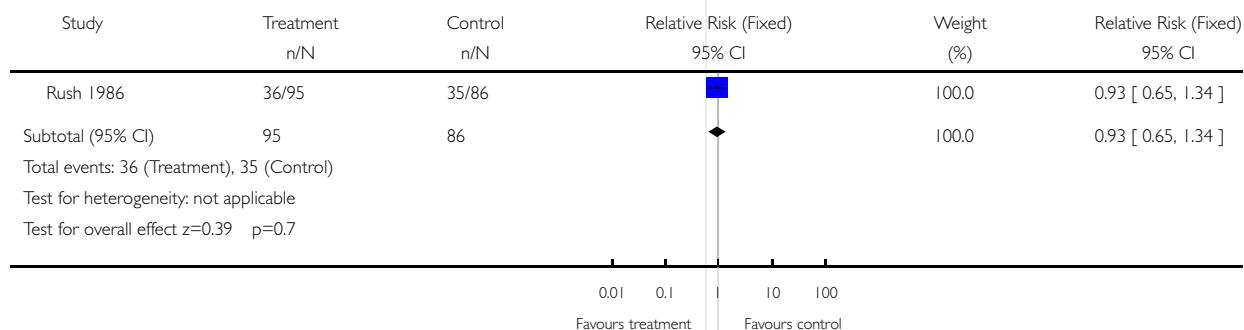


Analysis 08.01. Comparison 08 Washing cord vs dry cord care, Outcome 01 Bacterial colonization - Staphylococcus aureus

Review: Topical umbilical cord care at birth

Comparison: 08 Washing cord vs dry cord care

Outcome: 01 Bacterial colonization - Staphylococcus aureus

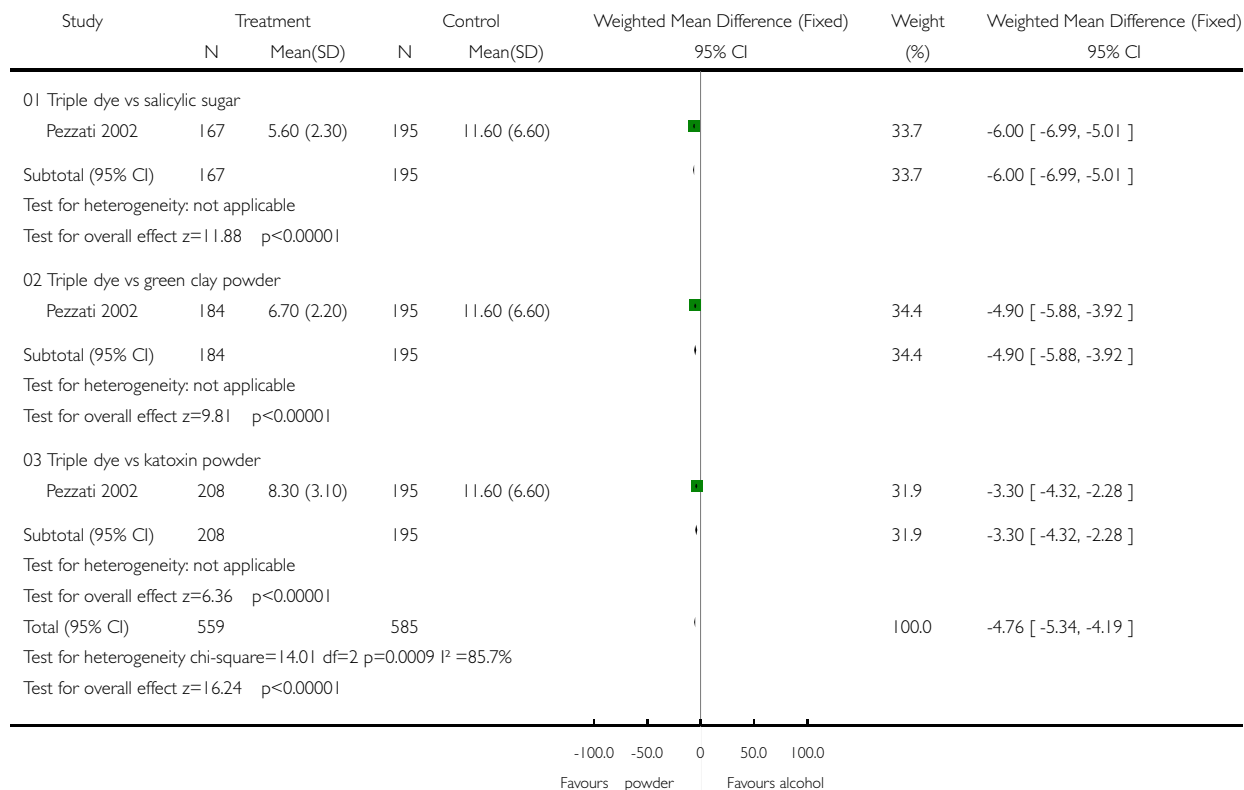


Analysis 09.01. Comparison 09 Antiseptic-aqueous based vs powder [Subgroup analysis], Outcome 01 Cord separation

Review: Topical umbilical cord care at birth

Comparison: 09 Antiseptic-aqueous based vs powder [Subgroup analysis]

Outcome: 01 Cord separation



Analysis 10.01. Comparison 10 Antiseptic-alcohol based vs powder [Subgroup analysis], Outcome 01 Cord separation

Review: Topical umbilical cord care at birth

Comparison: 10 Antiseptic-alcohol based vs powder [Subgroup analysis]

Outcome: 01 Cord separation

