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1 **Optimising Caesarean Section Use 3. Interventions to reduce unnecessary**  
2 **caesarean sections in healthy women and babies**

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27

## 28 **Key Messages Panel**

- 29 • Optimising caesarean section (CS) is of global concern. Underuse leads to higher perinatal  
30 mortality and morbidity and should remain a global health priority.
- 31 • Conversely, high rates of CS have not shown benefits, can be harmful and can commit resource  
32 use unnecessarily. Addressing overuse therefore also needs to be the focus of reaching optimum  
33 levels of CS around the world.
- 34 • Few clinical interventions have been tested in randomised trials with CS as a primary outcome.  
35 Although labour induction at or near term may reduce CS, the side effects, costs, and service  
36 user and provider acceptability of routine labour induction with no medical indication have not  
37 been established. Trials that include continuous labour support show similar reductions in CS  
38 rates to those of labour induction.
- 39 • Trials of non-clinical healthcare interventions suggest that approaches that prioritise positive  
40 human relationships, promote respectful and collaborative multidisciplinary teamwork and  
41 address clinician beliefs and attitudes, and women's fear of labour pain and of poor quality of  
42 care, might be effective in reducing CS or increasing physiological labour and birth. These include  
43 labour companionship, midwife-led continuity of care, midwife-led units, antenatal education,  
44 training and implementation of evidence based guidelines at the point of care along with  
45 mandatory second opinion and timely feedback to staff.
- 46 • Multifaceted (clinical and non-clinical) strategies are needed to reduce CS and/or to increase  
47 physiological birth for healthy women and babies. These must be scientifically tested, and  
48 tailored to local determinants (beliefs, norms, and behavioural factors that influence the key  
49 players, i.e. societal norms, women, health professionals, and healthcare organisations).
- 50 • Further research is needed to evaluate the effect of CS overuse on resolving concomitant  
51 underuse.

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54

## 55 **Summary**

56

57 Optimising caesarean section (CS) is of global concern. Underuse leads to higher maternal and  
58 perinatal mortality and morbidity. Conversely, CS high rates have not shown benefits and can create  
59 harm. Worldwide, CS rates continue to escalate and interventions to reduce unnecessary CS have  
60 shown limited success. Identifying the underlying factors for the continued rise could improve the  
61 efficacy of interventions. We describe the factors associated with women, families and societies;  
62 health professionals; and organisations and systems. We examine behavioural, psychosocial, health  
63 systems and financial factors. We outline the type and effect of interventions that have been subject  
64 to research to reduce CS rates. Clinical interventions such as external cephalic version for term  
65 breech, vaginal breech delivery in well selected cases, and vaginal birth after CS (VBAC), may

66 contribute to reduce CS rates. Approaches such as labour companionship and midwife-led care have  
67 been associated with higher rates of physiological birth, safe outcomes, lower healthcare costs, and  
68 positive maternal experiences in high-income countries. Such approaches need assessment in  
69 middle- and low-income countries. Educational interventions for women must be complemented  
70 with meaningful dialogue with health professionals, and effective emotional support. Investing in  
71 health professionals, eliminating financial incentives, and reducing fear of litigation is fundamental.  
72 Safe, private, welcoming, adequately resourced facilities are needed. At country level, effective  
73 leadership is essential to ensuring CS use only when needed. We conclude that interventions to  
74 reduce overuse must be multi-component and locally tailored, addressing women's and health  
75 professionals' concerns, and health system as well as financial factors.

76 This paper is the third in a three-part Series on optimising CS rates, and focuses on interventions to  
77 reduce unnecessary CS.

78

79

## 80 **Caesarean birth: over and beyond medical sense**

81

82 There is no debate about the need to increase access to safe CS where the procedure is underused.  
83 However, there is no evidence of benefit for women and babies who do not require the procedure,<sup>1</sup>  
84 and, as for any surgery, there are short- and long-term risks that have been outlined in the second  
85 paper of this Series.<sup>2</sup> In addition, where surgery is overused, this may limit resources that could be  
86 used to increase underuse.<sup>3</sup>

87 The optimal population-level CS rate escapes consensus.<sup>4</sup> Even the intent to develop a global  
88 standard is contested. However, there is almost universal consensus that, in many settings, current  
89 rates cannot be medically justified.<sup>5–8</sup> Underuse of CS has been the focus of literature, research,  
90 policy and funding efforts over decades, since lack of access to CS is a priority to reduce maternal  
91 and perinatal mortality and morbidity. Overuse, on the other hand, is a more recent and less well  
92 understood phenomenon that can coexist in many countries with underuse.<sup>9</sup> There may be the  
93 potential, therefore, to free up resources to address such underuse. This third paper in this Series on  
94 optimising CS rates is thus focused on interventions to reduce unnecessary CS, which we define as  
95 being performed in the absence of medical (including psychological) indications.<sup>10–12</sup>

96 We begin with an overview of the drivers behind increasing CS rates. We then examine the nature  
97 and effects of both clinical and non-clinical (behavioural, educational, psychosocial) interventions  
98 that have been tested in studies specifically designed to safely reduce CS births. We discuss the  
99 degree to which these interventions pay attention to the underlying drivers, and the mechanisms of  
100 effect that might underpin successful reduction strategies. Finally, we propose research priorities for  
101 the future.

102

## 103 **Drivers of “too many caesarean sections”**

104

105 Many decisions to undertake CS are driven by the clinical or psychological needs of the mother  
106 and/or baby. However, where rates are higher than needed, the drivers fall into three broader  
107 categories that sometimes overlap, and are interconnected. These relate to: 1) childbearing women,  
108 families, communities, and the broader society; 2) health professionals; and 3) healthcare systems,  
109 financing, and organisational design and cultures.

## 110 **Factors related to childbearing women, families, communities, and the broader society**

111 The notion of maternal request for CS has been variously interpreted, and widely debated.<sup>13–15</sup>  
112 Contrary to perceived opinion, however, the majority of women around the world do not prefer a CS  
113 in the absence of current or previous complications.<sup>16,17</sup> The most recent systematic review on  
114 worldwide preferences reported an overall pooled preference for CS of 15%, and only 10% when  
115 excluding women with a previous CS.<sup>16</sup>

116 For women who do favour CS in the absence of medical indications, reasons include fear of labour  
117 pain, particularly where epidural analgesia is not accessible or affordable,<sup>18–24</sup> fear of pelvic floor

118 damage and urinary incontinence,<sup>25,26</sup> or fear of a reduced quality of sexual life.<sup>26–28</sup> Contrary to  
119 scientific evidence, most women who prefer CS perceive it to be safer for the baby and for  
120 themselves.<sup>29–32</sup> Less commonly, women cite convenience as a reason, particularly in societies where  
121 women bear substantial work or family responsibilities,<sup>24,29</sup> or where they can also have a tubal  
122 ligation.<sup>19,26,33</sup> In some settings, there are perceived advantages for the child of an auspicious  
123 birthdate.<sup>18,24,28,34</sup> Previous negative experiences of vaginal birth, including suboptimal quality of  
124 care, and experiences of disrespect and abuse, also influence choice for CS birth in subsequent  
125 pregnancies.<sup>23,35–37</sup>

126 Contemporary society exposes pregnant women to a wide range of information on pregnancy and  
127 childbirth.<sup>38–41</sup> The media has a growing influence on the decision for elective CS.<sup>15,41–43</sup> Elective CS  
128 birth tends to be presented as controllable, convenient, more fashionable and modern.<sup>40–42</sup> A few  
129 studies suggest that the influence of fathers' preference is related to convenience, previous negative  
130 experience of a partner's labour or birth, or previous experience of a partner having a CS.<sup>44</sup>

### 131 **Factors related to health professionals**

132 Pregnant women tend to identify health providers as the most important influence on their decision  
133 about mode of birth.<sup>24,45,46</sup> In contrast, health providers report women's request as an important  
134 driver for performing non-medically indicated CS deliveries. A pan-European survey of 1530  
135 obstetricians found compliance with a hypothetical women's request for CS without medical  
136 indications to be lowest in Spain (15%) and highest in the UK (79%). Higher levels of fear of litigation,  
137 employment in a university-affiliated hospital, and being male, were all associated with an increased  
138 likelihood of agreement to a woman's CS request.<sup>6</sup>

139 In many countries, malpractice legal standards and systems leave providers vulnerable even if they  
140 deliver the best evidence-based care.<sup>47</sup> Contrary to scientific evidence, society in general believes  
141 that a CS is a protective procedure.<sup>48,49</sup> Consequently, practitioners are more likely to be sued for  
142 complications during vaginal delivery than for unnecessary CS, even if there is no evidence of  
143 error.<sup>47,48</sup> Being sued (even if unsuccessfully) can generate negative publicity, damage reputations  
144 and professional confidence, and even destroy careers.<sup>50–53</sup> This situation may result in performing a  
145 CS for professional protection, rather than to benefit the mother and/or baby.<sup>54</sup>

146 In some settings, most CS operations occur during working hours, and during weekdays, peaking on  
147 Fridays.<sup>55,56</sup> This suggests that the decision to perform a CS sometimes occurs for convenience. In  
148 settings where obstetricians combine public and private work, scheduling elective CSs allows for  
149 private work to be reconciled with public duties.<sup>34,53,57</sup>

### 150 **Factors related to healthcare systems, financial reimbursements, and organisational 151 design and cultures**

152 In many but not all settings, the rates of CS birth are higher in the private sector.<sup>58</sup> In Brazil, for  
153 example, 80–90% of all babies in the private sector are born by CS, compared with 30–40% in the  
154 public sector.<sup>59,60</sup> In some settings, private maternity care underpins the finances for whole  
155 hospitals. Where a CS can generate more income than a vaginal birth, incentives exist to persuade  
156 women that a CS is best for her and/or her baby.<sup>57</sup>

157 Lack of experience or skills in performing an assisted vaginal delivery has been associated with  
158 higher CS rates,<sup>53</sup> especially in settings where there is lack of training and supervision, and young  
159 physicians are afraid of showing signs of incompetency, or of 'disturbing' senior staff to ask for  
160 support.<sup>53</sup> In many settings, young obstetricians have become experts in CS, but are losing  
161 confidence in undertaking vaginal assisted deliveries and breech deliveries.

162 Women's experiences of poor quality antenatal environments, equipment, and health professional  
163 skills and interactions are associated with a lack of trust in the system and staff. This can trigger a  
164 decision to undergo a CS to avoid anticipated poor-quality labour and birth care.<sup>24,37</sup> In some low-  
165 resource settings, high CS rates in tertiary hospitals have been attributed to unskilled primary care  
166 professionals, who delay referral because they fail to detect danger signs. The transferred woman  
167 arrives late and in a critical condition and an emergency CS is the only solution.<sup>53</sup>

168 Figure 1 shows a schematic representation of all the non-clinical factors discussed above enclosing  
169 the obstetric and clinical factors that affect the rate of CS births (e.g. presentation, number of  
170 fetuses, previous CS), represented in the middle by the Robson's 10-group classification.<sup>61,62</sup> It is  
171 intended to visualise the layers of complexity of the factors involved.

172

## 173 **Interventions to reduce unnecessary caesareans**

174

175 Interventions to reduce unnecessary CS can be broadly conceptualised as clinical and non-clinical,  
176 though there is overlap between the two. The former tend to target a specific clinical practice for a  
177 particular woman (e.g. vaginal birth after CS, VBAC). The degree to which such interventions can  
178 reduce the CS rate may be limited because CS for clinical indications forms an increasingly smaller  
179 proportion of the overall rising rate that has been confirmed by the findings of the first paper in this  
180 Series.<sup>8</sup> The latter tend to address one or more aspects of the system of care design and/or delivery,  
181 and to be more multifactorial. The World Health Organization (WHO) has recently produced  
182 guidelines on antenatal and intrapartum care,<sup>63,64</sup> and these include recommendations on some of  
183 the clinical interventions that reduce CS and improve other outcomes for mother and baby. These  
184 and other clinical interventions are summarised below, followed by a more in-depth analysis of non-  
185 clinical interventions.<sup>65</sup>

### 186 **Clinical interventions**

187 Only two clinical interventions for healthy women and babies with no complications have been  
188 tested in randomised trials with a primary outcome of intrapartum (emergency) CS: routine  
189 induction of labour at or near term, and active management of labour. The routine induction trials  
190 either found no difference in CS rates<sup>66</sup> or reduced rates of CS.<sup>67-69</sup> The latest Cochrane review on  
191 this topic did not have mode of birth as a primary outcome, but did show a reduction in CS overall,<sup>70</sup>  
192 as did the recently completed ARRIVE trial of over 6000 low risk primigravid women randomised at  
193 or around 39 weeks' gestation (RR 0.84, 95% CI 0.76 to 0.93).<sup>71</sup> However, some induction-of-labour  
194 studies report increased rates of instrumental birth,<sup>67-70</sup> and women's views and experiences are  
195 rarely reported. In addition, recruitment rates seem to be low; for example, about a third of eligible  
196 women agreed to take part in the 35/39 trial, a randomised, controlled trial of primigravid women

197 35 years of age or older assigning women to labour induction at 39 weeks or to expectant  
198 management,<sup>66</sup> and 25% of those eligible agreed to take part in the ARRIVE trial.<sup>72</sup> This raises  
199 questions about women's willingness to undergo labour induction, and, consequently, about the  
200 external generalisability of the findings.

201 The most up to date Cochrane review of active management of labour (strict diagnosis of labour,  
202 routine amniotomy, oxytocin for slow progress, and one-to-one support in labour) shows no  
203 statistically significant difference in CS rates.<sup>73</sup> However, when authors excluded one low-quality  
204 study, the results showed a statistically significant reduction (RR 0.77, 95% CI 0.63 to 0.94). It has  
205 been suggested that the primary mechanism could be the one-to-one support component.<sup>73</sup> This  
206 hypothesis is strengthened by the most recent Cochrane review on continuous labour support,  
207 which found that continuous labour support may reduce CS rates (RR 0.75, 95% CI 0.64, 0.88),  
208 although CS was measured as secondary outcome.<sup>74</sup>

209 Although external cephalic version (ECV) is used to reduce CS in breech presentation, it does not  
210 appear to do so in trial conditions.<sup>75,76</sup> CS rates for breech presentation rose to near 100% in many  
211 settings following the publication of the results of the Term Breech Trial,<sup>75,77</sup> but the authors of the  
212 two-year trial follow-up noted that '*planned cesarean delivery is not associated with a reduction in*  
213 *risk of death or neurodevelopmental delay in children at 2 years of age*'.<sup>78</sup> Some centres are now  
214 offering carefully screened women the option of trying for a vaginal breech birth, with generally  
215 good outcomes.<sup>79</sup>

216 Women with a previous CS but who have no complications in a subsequent pregnancy, are often  
217 offered a trial of labour with a view to achieving VBAC. The only trial of VBAC in the relevant  
218 Cochrane review includes data on mode of birth for just 22 women, with no significant difference in  
219 CS rates.<sup>80</sup> A recent large European trial of this approach is due to report soon.<sup>81</sup> The influence of  
220 medical opinion leaders might improve the uptake of VBAC and consequently reduce CS rates.<sup>82</sup>  
221 Despite the lack of trial evidence on mode of birth, both ECV and VBAC are part of usual clinical  
222 practice in many settings, since they are associated with other benefits for mother and baby.<sup>83,84</sup>

223 Apart from studies with a primary outcome of reducing CS rates, randomised trial evidence suggests  
224 that limiting the "cascade" of interventions that women and babies are sometimes exposed to can  
225 increase rates of spontaneous vaginal birth. This may be achieved by midwifery led continuity of  
226 care;<sup>85</sup> planning labour in birth centres (in settings where there is access to rapid transfer); using  
227 intermittent auscultation rather than electronic fetal monitoring;<sup>86</sup> and continuous labour support.<sup>74</sup>

228 The evidence considered in the context of the drivers discussed above suggests that meaningful  
229 reductions in CS rates cannot be achieved by clinical interventions alone. Non-clinical interventions  
230 are more likely to be synchronous with these behavioural and psychosocial drivers.

### 231 **Non-clinical interventions**

232 Acknowledging that there is no clear dividing line between clinical and non-clinical interventions, we  
233 defined non-clinical interventions as those that are applied independently of a clinical encounter  
234 between a specific healthcare provider and a particular service user.<sup>65</sup> Recent WHO  
235 recommendations on this topic (web appendix Table 1) drew on an updated Cochrane review (29  
236 included studies),<sup>12</sup> and three qualitative evidence syntheses on women's and providers' views,

237 values, beliefs and perceptions about CS, and factors related to organisations, facilities and systems  
238 (49 studies reported in 52 papers).<sup>45,87,88</sup> Below we present a summary of the findings of these  
239 reviews.

#### 240 ***Interventions targeted at women, families and communities***

241 Among other drivers identified above, fear, concerns about safety, convenience, and mis-  
242 information, and wider society/peer group norms were all relevant for decision making about mode  
243 of birth for women and families. The effectiveness evidence in this area is derived from 12  
244 randomised controlled trials, all comparing specific education, support programmes, and birth  
245 preparation classes with usual practices, and mostly addressing knowledge, anxiety and fear.<sup>12</sup> Three  
246 interventions (web appendix Table 2) (tested in small studies with fewer than 200 participants each)  
247 reduced CS births: nurse-led applied relaxation training programme (Iran),<sup>89</sup> psychosocial couple-  
248 based prevention programme (United States),<sup>90</sup> and childbirth training workshop (Iran).<sup>91</sup> In addition,  
249 one Finnish study of 371 women with fear of childbirth reported no significant effect on the overall  
250 rate of CS but a 33% increase in spontaneous vaginal births.<sup>92</sup> All were low-quality, single-site  
251 studies.

252 Three studies assessed different formats of educational intervention in women with a previous CS:  
253 role play education versus lectures in nulliparous women (Iran);<sup>93</sup> interactive decision aids versus  
254 educational brochures (USA),<sup>94</sup> and individualised prenatal education and support versus written  
255 information pamphlets (Canada).<sup>95</sup> None of these three studies showed significant differences in  
256 rates of CS or VBAC.<sup>12</sup>

257 The qualitative evidence synthesis was based on 12 studies published between 2001 and 2016,  
258 undertaken in Australia, Brazil, Canada, Norway, Taiwan, UK and USA, in mostly urban settings.<sup>45</sup> The  
259 studies encompassed both highly motivated women who expressed an intense desire for  
260 engagement, and those who wanted the provider to make relevant decisions. Across all groups,  
261 pregnant women welcomed educational interventions. They reported that new knowledge could be  
262 empowering, informing more meaningful dialogue with providers, assuming the content and format  
263 did not provoke anxiety. Women welcomed online and digital information, but many still wanted  
264 printed copies to reflect on, and to revisit with family and friends.<sup>96</sup>

265 Face-to-face dialogue with health professionals was reported to be a strong influence on decisions  
266 about birth mode, especially when clinicians recognised childbirth as an emotional experience,  
267 rather than just a clinical process. Frustration and mistrust resulted when women felt they were not  
268 listened to, or that advice provided was inconsistent.

#### 269 ***Interventions targeted at health professionals***

270 Concerns about litigation, organisational and peer group norms, and financial benefits and  
271 convenience were identified above as drivers of health professional use of CS in some cases.  
272 Interventions directed at health professionals have included educational packages to improve  
273 adherence to evidence-based clinical practice, second-opinion policies, audit and feedback, and  
274 peer-review of CS indications.<sup>12</sup> Two interventions were found to slightly reduce the CS rate with  
275 high-certainty evidence (web appendix Table 2): implementation of evidence-based guidelines  
276 combined with structured, mandatory second opinion (sites in Argentina, Brazil, Cuba, Guatemala

277 and Mexico),<sup>97</sup> and implementation of evidence-based guidelines combined with CS audits and  
278 timely feedback (multiple sites in Canada).<sup>98</sup>

279 Qualitative evidence synthesis of health professionals' views and experiences of non-clinical  
280 interventions to reduce unnecessary CS included 17 studies (2005–2017) from 17 countries  
281 (Australia, Canada, China, Ethiopia, Finland, Germany, Iran, Ireland, Italy, Kenya, Netherlands,  
282 Nicaragua, Sweden, Tanzania, Uganda, UK and USA), in both rural and urban settings.<sup>88</sup>

283 Health professionals' beliefs about birth (on a continuum from considering it a normal physiological  
284 process to inherently pathological) informed both their knowledge about what constitutes necessary  
285 and unnecessary CS, and the importance they attached to reducing overuse. Some obstetric  
286 residents reported a need for improved communication, while also fearing that seeking a second  
287 opinion could negatively impact on their clinical credibility and career. Some professionals were  
288 opposed to second-opinion policies because of consequent difficulties in medico-legal  
289 responsibilities. A few welcomed guidelines as providing a defensible basis for their practice (rather  
290 than as a basis for good practice per se), while others resisted guideline-directed practice, believing  
291 that they only intervened when necessary.

292 Responses to interventions like audit and feedback were influenced by fear of blame and  
293 recrimination, the value attached to personal financial reward, preference for CS as an efficient birth  
294 method that can be scheduled, and beliefs about women (including their perceptions of women's  
295 preparedness to give birth vaginally, lack of antenatal education, sedentary lifestyles and increasing  
296 rates of obesity). Doubts about local validity of guidelines, keeping them up-to-date and lack of  
297 resources limited implementation of guidelines. In European settings, health professionals  
298 experienced interventions targeted at overuse as most acceptable where this vision was shared  
299 within and between multidisciplinary groups, and when they felt supported by colleagues and  
300 opinion leaders.

### 301 ***Interventions targeted at organisations, facilities, and systems***

302 As noted above, the drivers for CS at the systems level included financing and care-provision models,  
303 system integration, and environmental and resourcing conditions. Interventions at this level to  
304 reduce CS births include changes in organisational culture, insurance reforms, external peer review,  
305 legislative policy limiting legal liability in case of litigation, facility staffing models, specific goals for  
306 CS rates, and targeted financial strategies.<sup>12</sup>

307 Three studies were identified (web appendix Table 2).<sup>65</sup> A single-site study in the USA tested a  
308 change in the model of care<sup>99</sup> by switching privately insured women from a physicians' private-  
309 practice approach to a model of care provided primarily by midwives with 24-hour in-house  
310 obstetrician back-up without other competing clinical duties. This led to a significant decrease in the  
311 rate of primary CS and an increase in VBACs. The other two studies were of very low quality  
312 (uncertain evidence). They assessed financial incentives for health professionals. In one hospital in  
313 the USA, equalising physician fees for vaginal and CS delivery resulted in a non-significant reduction  
314 in CS rates.<sup>100</sup> In Taiwan, the National Health Insurance scheme raised the fee for a vaginal birth to  
315 the level of CS, without a significant effect on CS rates.<sup>101</sup>

316 Qualitative evidence synthesis in this area included 25 studies (1993–2016) from 17 countries (nine  
317 from Europe or North America, five from Africa, four from Latin America, three from China, two from  
318 Iran, one from Bangladesh, and one from Lebanon), in rural and urban settings.<sup>87</sup> Some participants  
319 worked in settings where the organisational culture endorsed maternal request for CS, and/or where  
320 there was the belief that quality of care was compromised by reductions in CS rates. In other  
321 settings, reducing CS rates was believed to enhance overall quality of care. This influenced whether  
322 changes in the physical birth ambience to encourage labour and vaginal birth were properly  
323 maintained or not, and whether any change was followed or ignored by staff.

324 There was a consistent message across studies and countries that the birth environment was an  
325 amalgam of both the physical structures and resources, and of the state of relationships between  
326 professionals and stakeholders, all contributing to a sense of the organisational ethos. In Iran,  
327 Lebanon and Nicaragua, substandard conditions in maternity care were reported as significant  
328 barriers to reducing unnecessary CS. Critically, the balance of power between doctors, midwives,  
329 nurses, other maternity care providers, and childbearing women strongly influenced willingness to  
330 engage or not with improving the organisational ethos. Respectful multidisciplinary teamwork and  
331 communication seemed to be fundamental to promoting efforts to reduce CS rates.<sup>87</sup>

332

## 333 **Unpacking mechanisms of effect**

### 334 **What makes the difference?**

335 The data we present suggest that very few interventions (clinical or non-clinical) have paid attention  
336 to the multiple drivers of high CS rates and their interactions<sup>45,87,88</sup> which are complex, dynamic, and,  
337 to an extent, context-specific. As a consequence, very few have been effective in reducing  
338 unnecessarily high CS rates.<sup>7,12</sup> For example, addressing preparedness and knowledge of pregnant  
339 women while ignoring healthcare providers' demand for skills and training or for more pro-vaginal  
340 policies on birth malpractice is unlikely to reduce CS births. In addition, the interactions between  
341 factors may require continuous adaptations and change. For example, positive reputation and  
342 respectful relationships between different cadres or between providers and pregnant women and  
343 communities need time, effective communication and understanding. Incremental adaptations may  
344 result in more sustainable results than drastic artificially imposed changes in already tense  
345 environments.

346 Interventions for women need to engender a sense of empowerment. They need to be implemented  
347 in conjunction with meaningful dialogue with health professionals and with those who set maternity  
348 care norms in local communities. They should include recognition of previous experience of birth,  
349 short- and long-term effects of CS on women and children and be provided in the context of  
350 effective emotional support.

351 Professional norms, beliefs and values that influence local decision making in practice tend to  
352 operate independently of (and sometimes despite) the known evidence base. Mutually respectful  
353 multidisciplinary teamwork where all staff groups are authentically working to optimise positive,  
354 safe childbirth seems to be a characteristic of some services that have safely reduced CS rates, as  
355 part of an overall programme of good-quality care. Barriers to effective collaboration and

356 communication need to be removed to increase the chances of success. Appropriate management  
357 of the change process, including changes in work patterns, workloads, skills, and professional ethos  
358 that some new approaches require, is also crucial.

359 The importance of effective, tailored and continuous professional education, training, and support  
360 cannot be overstated. Staff need to have, and maintain, the skills to provide flexible support for  
361 individual women in their pursuit of safe normal or vaginal instrumental birth, and good decision  
362 making about when interventions are needed along with continuous quality improvement. This is  
363 essential to reduce fear of litigation.

364 Health systems are the hardware supporting or undermining clinical and professional efforts for  
365 change. The overall organisational ethos is important, and needs to be understood and addressed.  
366 The creation of safe, private, welcoming, adequately resourced labour and birth environments that  
367 optimise a sense of being relaxed and supported for women and for health professionals is essential.

368 Notably, the first step for success is local recognition of the problem. Changes externally imposed on  
369 facilities and professionals are a recipe for failure. Participatory approaches are more likely to be  
370 effective. At both country and facility level, strong and responsive leadership and authentic,  
371 sustainable commitment to reduce unnecessary CS are crucial. The reduction of overuse requires a  
372 change in organisational mentality and needs high visibility. Bringing this to the attention of the  
373 public requires production and distribution of printed, audio-visual, and virtual material as well as  
374 social and mass media coverage.

### 375 **Implementing change effectively**

376 While all the factors discussed in this article are essential elements in the equation, their sheer  
377 volume can seem overwhelming (Figure 1). Implementation and improvement science offers a range  
378 of theories to operationalise effective interventions.<sup>102-104</sup> Successful initiatives for complex health  
379 systems have used participatory methods and action-led processes to build audit and change cycles  
380 into the intervention process.<sup>105,106</sup> These implementation mechanisms allow for more flexible  
381 designs to integrate local barriers and mediators while still incorporating population-level evidence.  
382 They overcome the sense of helplessness that can arise when faced with the apparent complexity of  
383 insufficient human resources or materials, suboptimal communication, toxic power relations,  
384 perverse financial incentives, and adverse professional and societal norms. When compared with  
385 simple, linear, top-down interventions that demand fidelity to very specific components,  
386 participatory approaches and subsequently adapted actions identify exactly where in the local  
387 system change is possible, and adopt multiple interventions that address all the locally relevant  
388 blocking factors.<sup>104-106</sup> Indeed, recent evidence from specific sites and regions in China suggests that  
389 using multi-level interventions that include change in government policy, financial incentives, local  
390 benchmarking, education of staff and of service users, provision of doula support and access to pain  
391 relief, can limit the rise in CS rates.<sup>107,108</sup>

### 392 **Future research priorities**

393 With some exceptions, interventions tested to date to reduce unnecessary CS have been single-  
394 faceted, targeted to one group (e.g. women or healthcare providers), tested in a single site or  
395 country with a relatively small number of participants, and providing low- or very low-quality

396 evidence. Women's views and experiences were often not included, and medium- and long-term  
397 follow up was not undertaken. Studies have rarely considered the qualitative evidence of what might  
398 work for a particular barrier or facilitator. Future interventions are unlikely to be effective if they  
399 repeat these errors. The consideration of the local context, culture, norms, practice and pre-existing  
400 initiatives is essential not only for the optimal design of the intervention and its components but also  
401 as mediators to negotiate and overcome resistance to change.<sup>109–111</sup>

402 Supportive models of care, including labour companionship,<sup>74</sup> midwife-led continuity of care,<sup>85</sup> and  
403 midwife-led units,<sup>112</sup> provide promising approaches. They tend to prioritise positive human  
404 relationships, and to optimise physiological labour and birth for healthy women and babies. In trials  
405 in high-income countries, these models have also been associated with safe outcomes, lower  
406 healthcare costs, and positive maternal experiences for both healthy women and babies, and those  
407 with complications. The feasibility and applicability of such approaches now need to be assessed in  
408 middle- and low-income countries.

409 Research is also needed to evaluate the effect of overuse of CS on resolving concomitant underuse.  
410 Promising ideas that could optimise both over- and underuse, but that require more research,  
411 include ways of changing organisational ethos and culture, of maximising respectful intra- and inter-  
412 professional teamworking, and provider–women relationships; financial interventions that may  
413 involve physicians individually but also hospitals or whole systems; maintaining reimbursement costs  
414 of vaginal delivery close to those for CS or even higher; establishing targets for CS rates at facility  
415 level; or public dissemination of CS rates by hospital.<sup>109,110,113–115</sup>

416 Across ideas, complex interventions are challenging to develop, evaluate, document and reproduce,  
417 and are subject to more variation than a drug.<sup>109,116</sup> Many complex interventions are implemented in  
418 contexts that prioritise action over generation of evidence.<sup>104,110,113,117</sup> In general, future research in  
419 this area should be based on well-designed participatory and action-focused studies that unify the  
420 rigour of research and the flexibility needed to optimise complex multifaceted interventions.<sup>104,105</sup>  
421 Proper evaluation of the effectiveness of any intervention before widescale implementation takes  
422 place is critical. Additionally, new interventions need to be designed and tested, based on the drivers  
423 for higher or lower rates of CS identified in the qualitative data presented in this paper.

424 Among the few studies that exist in this area, even fewer are based in low-income countries, though  
425 these are also experiencing rising rates of unnecessary CS births in parallel with underuse.<sup>9</sup> Future  
426 studies should also address drivers and interventions relevant to these other countries, where  
427 inequities in the use of CS are more prevalent, and detrimental effects much higher.<sup>9</sup>

428

## 429 **Conclusion**

430

431 Although there is almost universal consensus that current CS rates have transgressed reasonable  
432 justification of need, effective interventions to optimise CS births by increasing underuse and  
433 reducing overuse have proven elusive. Their limited success may be due to the complexity of the  
434 factors driving the under- and the overuse of CS worldwide and the prevalent approach in research  
435 to focus on single interventions that target only one driver. Given the issues discussed in this paper,

436 addressing overuse is critical to optimising maternity care experiences and outcomes. New multi-  
437 component interventions that can be tailored to local contexts and drivers should be devised to  
438 address the concerns of women and health professionals, as well as the limitations of health  
439 systems.

440 A CS is not a stand-alone event, and it is not intrinsically an adverse outcome. Indeed, reducing CS  
441 below safe levels, or replacing it with badly performed instrumental birth, is more likely to cause  
442 harm than good. However, most healthy women would prefer to labour and give birth  
443 physiologically if possible<sup>16</sup> and this outcome is most likely to be associated, as outlined in the  
444 second paper of this three-part Series, with optimal wellbeing for both mother and baby in the short  
445 and longer term, as well as being more sustainable for healthcare systems.<sup>2</sup> Qualitative and  
446 effectiveness data suggest that interventions that prioritise positive human relationships, promote  
447 respectful and collaborative multidisciplinary teamwork and address clinician beliefs and attitudes,  
448 and women’s fear of labour pain and of poor quality of care, might be effective in reducing  
449 unnecessary CS and/or safely increasing physiological labour and birth. These include labour  
450 companionship, midwife-led continuity of care, midwife-led units, antenatal education, training and  
451 implementation of evidence based guidelines at point of care along with mandatory second opinion  
452 and timely feedback to staff.

453 Comparing CS rates in a standardised, meaningful, and action-oriented manner (such as through the  
454 Robson groups criteria) is critical.<sup>61,118</sup> Where overuse is identified, the issue should be brought to  
455 the attention of the public in general, and should be high on the political agendas of countries with  
456 disproportionately high rates, especially where this occurs in parallel with underuse for some  
457 population groups. Reduction strategies require interventions that take account of the drivers  
458 identified in this paper, and that recognise the need to influence change in the beliefs and attitudes  
459 of providers, service users, and societies.

460

## 461 **Competing interests**

462 None

463

## 464 **Disclosures**

465 None

466

## 467 **Authors' contributions**

468 APB, MT, CK, NO and SD conceived and drafted the outline of the manuscript. APB, MT, CK, NO and  
469 SD wrote the first draft of the manuscript. APB and NO conceived and constructed table 1. CK  
470 conceived figure 1 with contributions from APB and SD. AM, MRT, JZ, MO, SZW and AMG  
471 contributed with substantial comments to the writing of the manuscript. APB, MT, CK, AM, NO, MRT,  
472 JZ, MO, SZW, AMG and SD read and approved the final manuscript.

473 APB, CK, NO and SD had full access to the data from the systematic reviews. APB, MT and SD had  
474 final responsibility for submission of the manuscript.

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**Panel 1: Search strategies****Cochrane systematic review**

We searched CENTRAL, MEDLINE, Embase, CINAHL and two trials registers (International Clinical Trials Registry Platform [ICTRP] and ClinicalTrials.gov) in August 2014, February 2017 and March 2018. Search strategies were comprised of keywords and controlled vocabulary terms (Medical Subject Heading [MeSH]) for CS and targeted non-clinical interventions. Searches for this update aimed to retrieve studies published since 2010 (i.e. the date of the searches in the previous version of the Cochrane review). The search terms were revised to increase specificity by analysing the titles, abstracts and MEDLINE index terms of the included studies from the previous version of the review using various text analysis tools (TerMine, Voyant Tools and Yale MeSH Analyzer). We applied no language limitations in the searches. We also searched reference lists of trials and related reviews, websites of relevant organisations, and contacted authors for additional articles. The complete search strategy is presented in the full review.

**Qualitative evidence syntheses**

Search strategies for electronic databases were developed building on preliminary scoping searches, terms used by existing quantitative reviews of interventions to reduce unnecessary CS, guidelines developed by the Cochrane Qualitative Research Methods Group, and papers detailing strategies for optimising the identification of qualitative studies in CINAHL, MEDLINE, EMBASE and PsycINFO. CINAHL, MEDLINE, PsycINFO, EMBASE, Global Index Medicus, POPLINE, and African Journals Online were searched for eligible studies published between 1 January 1985 and the date of final search (22 March 2017), to identify studies since the first WHO statement on appropriate technology for childbirth. We had no language or geographic restrictions. As retrieval of qualitative research using databases alone is limited, the reference lists of all the included studies and existing quantitative reviews were back and citation chained. In addition, key articles cited by multiple authors (citation pearls) were checked on Google Scholar. The authors of published protocols were also contacted. Complete search strategies are presented in the individual reviews.

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489 Figure 1: Schematic representation of women, societal, providers and organisation factors affecting  
490 CS rates at local level and enclosing the obstetric and clinical factors that also affect the rate of CS  
491 births represented in the middle by the Robson's 10-group classification.

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