PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Caesarean Sections and Private Insurance: Systematic Review and Meta-analysis
AUTHORS	Hoxha, Ilir; Syrogiannouli, Lamprini; Braha, Medina; Goodman, David C; da Costa, Bruno; Jüni, Peter

VERSION 1 - REVIEW

REVIEWER	Gwyn Bevan London School of Economics & Political Science England
REVIEW RETURNED	14-Mar-2017

GENERAL COMMENTS	The objective of this study is to determine the odds ratio (OR) of caesarean section (CS) over vaginal delivery for private insurance compared with public insurance. The paper explains that there are concerns over the appropriateness of CS because these rates vary within and between countries and have increased over time. The paper rightly argues that these increases and variations cannot be explained by clinical factors alone and hence are likely to be attributable to financial incentives. The paper states that: 'Financial incentives associated with private insurance seem to influence supplier behaviour, be that physician or hospital, affecting this way clinical decision as to whether perform CS or not' (p 6). The paper reports the results of a systematic review and meta-analysis of the association of insurance status of women with the odds ratio (OR) of delivery by CS. The outcomes were the crude and adjusted OR of births delivered by CS of women covered with private insurance as compared with women with public insurance. The paper describes its rigorous methods of the systematic review, the extraction of data from that review, and the statistical analyses. The authors undertook sensitivity analysis to handle the five studies excluded from the main analysis, because they had an overlapping population with a larger study that was included. The systematic review found 18 articles describing 21 separate studies in 12.9 million women, which were included in the meta-analysis. Table 1 describes these 21 studies, 19 of which are from the US, and one each from Ireland and Australia. The general finding from these studies is that: 'the overall odds of receiving a caesarean section are on average 1.14 times higher for privately insured women compared with women covered with public insurance' (p 9). The paper discusses the underlying mechanism as being that 'Health insurers are known to reimburse hospitals and physicians at higher rates for CS' (p 11). So the key driver identified is methods of reimbursement rather than insurance status, and these different financial incentives for CS and vaginal delivery may

	apply to both private and public insurance. And hence, the, albeit unstated implication is that arrangements for private insurance systematically have higher reimbursement rates for CS over vaginal delivery than public insurance. But the study's findings show that this is not so. The study found that for different states in the US adjusted estimates of the OR for CS for private and public insurance 'ranged from 0.96 in Maryland to 2.09 in Florida' (p 8). The details for eight states given in Appendix 4, which shows Florida to have been an outlier (mean OR = 2.09); and four states to have OR values that were not statistically significant from 1 (at the 5% significance level): Arizona (mean OR = 1.02), Maryland (mean OR = 0.96), Michigan (mean OR = 1.01), and Ohio (mean OR = 1.00). The authors have explanations for two of these four states only, namely, Arizona and Maryland. These explanations are that these States have developed payment systems that sought to avoid higher rates of reimbursement for CS than vaginal birth: in Arizona the payment is the same; in Maryland it seems that State policies that introduced managed care for Medicaid beneficiaries also resulted in 'more patients receiving managed care irrespective of their insurance status' (p 12). So this analysis shows that what matters in explaining variations in CS rates within the US are the differences in reimbursement arrangements for CS and vaginal delivery rather than the categories of 'public insurance' and 'private insurance'. More generally there is a problem in comparing 'public insurance' and 'private insurance' across countries, as the meaning of that distinction varies so much. In the US, where most of these studies were based, 'public insurance' is mainly categorical (by age, disability, poverty or military service) and 'private insurance' mainly organized through employment. In the UK where there is universal coverage through public insurance, private insurance is typically a perk as part of remuneration package. In the Netherlands, universal coverage is organized through competing private insurers. For the two countries other than the US were that included in the analyses of this paper, Ireland and Australia, 'private health insurance' is a complex and contested issue and differs in character from each other and from the US. In Australia government polices were designed with tax incentives for citizens to take out private insurance. Einarsdóttir et al (2012) argue these policies were targeted at younger people, hence at women of childbearing age, which would have increased use of private obstetricians (rather than midwives) and hence a higher rates of CS. In Ireland the problems with private insurance have been that this has created inequity in access to health care, which remains a problem (Burke et al, 2016). The findings of this systematic review and the authors' investigation of the material differences found by individual studies show that examining differences between public and private insurance to explain differences in rates of CS and vaginal deliveries does not target the drivers of these differences. These include rates of reimbursement and access to obstetricians. So the paper needs to argue that, although there is a body of literature that has examined differences in services provided using the categories of 'public insurance' and 'private insurance', these categories are not helpful, because we can only understand what drives the differences between them by unpacking what these are in terms of access and reimbursement.

	References Burke, S. A., Normand, C., Barry, S., & Thomas, S. (2016). From universal health insurance to universal healthcare? The shifting health policy landscape in Ireland since the economic crisis. Health Policy, 120(3), 235-240. Einarsdóttir, K., Kemp, A., Haggar, F. A., Moorin, R. E., Gunnell, A. S., Preen, D. B., ... & Holman, C. A. J. (2012). Increase in caesarean deliveries after the Australian private health insurance incentive policy reforms. PloS one, 7(7), e41436.

REVIEWER	Marie Delnord Inserm UMR 1153, Obstetrical, Perinatal and Pediatric Epidemiology Research Team (Epopé), Center for Epidemiology and Statistics Sorbonne Paris Cité, DHU Risks in pregnancy, Paris Descartes University, Paris, France
REVIEW RETURNED	29-Mar-2017

GENERAL COMMENTS	General comment: Statistical methods are appropriate. However, authors should check for publication bias to assess if studies with negative results (i.e. no difference between odds of CS for public/private insured women) were less likely to be included using a funnel plot (size of the study against measure of the effect). This is important as the the random effects meta-analysis assesses the average intervention (ie. private insurance) effect. Minor comments below: p6.Line 50: awkaward phrasing " to combine overall OR". Perhaps "to estimate the pooled OR" is more clear p6.Line 57: other more stringent thresholds for interpreting tau2 are also used. Kotonpantelis et al. capture low, medium and large levels of heterogeneity using values of 0.01, 0.03 and 0.10 respectively (In https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3724681/pdf/pone.0069930.pdf).

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Comment 1: The objective of this study is to determine the odds ratio (OR) of caesarean section (CS) over vaginal delivery for private insurance compared with public insurance. The paper explains that there are concerns over the appropriateness of CS because these rates vary within and between countries and have increased over time. The paper rightly argues that these increases and variations cannot be explained by clinical factors alone and hence are likely to be attributable to financial incentives. The paper states that: 'Financial incentives associated with private insurance seem to influence supplier behaviour, be that physician or hospital, affecting this way clinical decision as to whether perform CS or not' (p 6). The paper reports the results of a systematic review and meta-analysis of the association of insurance status of women with the odds ratio (OR) of delivery by CS. The outcomes were the crude and adjusted OR of births delivered by CS of women covered with private insurance as compared with women with public insurance.
Response: Thank you for your comments.

Comment 2: The paper describes its rigorous methods of the systematic review, the extraction of data

from that review, and the statistical analyses. The authors undertook sensitivity analysis to handle the five studies excluded from the main analysis, because they had an overlapping population with a larger study that was included.
Response: Thank you for your comments.

Comment 3: The systematic review found 18 articles describing 21 separate studies in 12.9 million women, which were included in the meta-analysis. Table 1 describes these 21 studies, 19 of which are from the US, and one each from Ireland and Australia. The general finding from these studies is that: 'the overall odds of receiving a caesarean section are on average 1.14 times higher for privately insured women compared with women covered with public insurance' (p 9). The paper discusses the underlying mechanism as being that 'Health insurers are known to reimburse hospitals and physicians at higher rates for CS' (p 11). So the key driver identified is methods of reimbursement rather than insurance status, and these different financial incentives for CS and vaginal delivery may apply to both private and public insurance. And hence, the, albeit unstated implication is that arrangements for private insurance systematically have higher reimbursement rates for CS over vaginal delivery than public insurance. But the study's findings show that this is not so.
Response: We have revised sentence "Existing evidence points towards two possible causes for higher odds of CS in women insured privately: payment mechanisms of health insurance bodies and health care providers' responses to these mechanisms. Most insurers pay for higher volume of care through fee-for-service reimbursement). Health insurers are known to reimburse hospitals and physicians at higher rates for CS compared with vaginal delivery and they can also differ in rates of reimbursement of CS." To "Existing evidence suggests that possible causes for higher odds of CS in women insured privately lie in the differences in payment for CS and reimbursement arrangements among insurers as well as providers' responses to these arrangements. In the countries included in our analysis, private health insurers generally reimburse hospitals at higher fees for providing a CS compared to the public insurers. This incentive is heightened when public insurance funds hospital care through a budget (e.g. Australia and Ireland) rather than fee-for-service, which is common in private insurance. Similar incentives are present in physician payment." (Page 10, paragraph 3 of the manuscript)
We also have revised sentence "These setting specific analyses are essential as incentives may differ across health care systems." to "These setting specific analyses are essential as incentives and reimbursement arrangements within health insurance schemes may differ across health care systems." (Page 13, paragraph 1 of the manuscript)
We have also revised paragraph "Review of setting-specific reimbursement policies will enable an understanding of influencing factors. Reforming reimbursement policies used by private and public insurers may lead to a reduction of CS rates to more appropriate levels." to "Review of setting-specific payment levels and reimbursement arrangements within health insurance schemes will enable a better understanding of influencing factors. Efforts to address payment levels for delivery procedures and reform of reimbursement arrangements may lead to a reduction of CS rates to more appropriate levels." (Page 13, paragraph 3 of the manuscript)

Comment 4: The study found that for different states in the US adjusted estimates of the OR for CS for private and public insurance 'ranged from 0.96 in Maryland to 2.09 in Florida' (p 8). The details for eight states given in Appendix 4, which shows Florida to have been an outlier (mean OR = 2.09); and four states to have OR values that were not statistically significant from 1 (at the 5% significance level): Arizona (mean OR = 1.02), Maryland (mean OR = 0.96), Michigan (mean OR = 1.01), and Ohio (mean OR = 1.00). The authors have explanations for two of these four states only, namely, Arizona and Maryland. These explanations are that these States have developed payment systems that sought to avoid higher rates of reimbursement for CS than vaginal birth: in Arizona the payment is the same; in Maryland it seems that State policies that introduced managed care for Medicaid beneficiaries also resulted in 'more patients receiving managed care irrespective of their insurance status' (p 12). So this analysis shows that what matters in explaining variations in CS rates within the

US are the differences in reimbursement arrangements for CS and vaginal delivery rather than the categories of ‘public insurance’ and ‘private insurance’.
Response: We partially agree with your comment/conclusion. To address you comment we have added the sentence “This analysis shows that variation in CS rates among insurers within the United States can be explained by differences in reimbursement arrangements nested within public and private insurance.” (Page 12, paragraph 1 of the manuscript)

Comment 5: More generally there is a problem in comparing ‘public insurance’ and ‘private insurance’ across countries, as the meaning of that distinction varies so much. In the US, where most of these studies were based, ‘public insurance’ is mainly categorical (by age, disability, poverty or military service) and ‘private insurance’ mainly organized through employment. In the UK where there is universal coverage through public insurance, private insurance is typically a perk as part of remuneration package. In the Netherlands, universal coverage is organized through competing private insurers.
Response: To address this comment we have added the sentence: “Comparing ‘public insurance’ and ‘private insurance’ across countries is not a straightforward exercise as the meaning of such distinction can vary substantially across countries. In the United States ‘public insurance’ is insurance assigned to specific categories of population (by age, disability, poverty or military service) and ‘private insurance’ is insurance mainly organized through employment. In general, private insurance offers higher reimbursement rates for surgical procedures, and this may incentivize CS.” (Page 11, paragraph 3 of the manuscript)

Comment 6: For the two countries other than the US were that included in the analyses of this paper, Ireland and Australia, ‘private health insurance’ is a complex and contested issue and differs in character from each other and from the US. In Australia government polices were designed with tax incentives for citizens to take out private insurance. Einarsdóttir et al (2012) argue these policies were targeted at younger people, hence at women of childbearing age, which would have increased use of private obstetricians (rather than midwives) and hence a higher rates of CS. In Ireland the problems with private insurance have been that this has created inequity in access to health care, which remains a problem (Burke et al, 2016).
Response: We have added a paragraph “For the other two countries, Ireland and Australia, included in the adjusted analysis, ‘private health insurance’ status differs in character from the United States but offers similarly higher payment levels for procedures. In Australia, women of childbearing age with private insurance, would have increased the use of private obstetricians, leading to higher rates of CS. In Ireland, the financial incentives in private insurance are similar, and are associated with striking inequities in care.” (Page 12, paragraph 2 of the manuscript)

Comment 7: The findings of this systematic review and the authors’ investigation of the material differences found by individual studies show that examining differences between public and private insurance to explain differences in rates of CS and vaginal deliveries does not target the drivers of these differences. These include rates of reimbursement and access to obstetricians. So the paper needs to argue that, although there is a body of literature that has examined differences in services provided using the categories of ‘public insurance’ and ‘private insurance’, these categories are not helpful, because we can only understand what drives the differences between them by unpacking what these are in terms of access and reimbursement.
Response: We respectfully disagree. We think that insurance status in the included countries is a good marker for higher reimbursement for private health insurance which incentivize CS. We do agree though that the arrangements within health insurance schemes are often complex. To address this comment, we have added the sentence as follows: “We recognize that while categories ‘public insurance’ and ‘private insurance’ are useful markers of higher reimbursement rates, other aspects of insurance reimbursement may also influence the odds of CS.” (Page 13, paragraph 1 of the manuscript)

Comment 8: References
Burke, S. A., Normand, C., Barry, S., & Thomas, S. (2016). From universal health insurance to universal healthcare? The shifting health policy landscape in Ireland since the economic crisis. Health Policy, 120(3), 235-240.
Einarsdóttir, K., Kemp, A., Haggar, F. A., Moorin, R. E., Gunnell, A. S., Preen, D. B., ... & Holman, C. A. J. (2012). Increase in caesarean deliveries after the Australian private health insurance incentive policy reforms. PloS one, 7(7), e41436.
Response: Thank you for sharing them with us. We have used both these references. (Page 19, references 53 and 54 of the manuscript)

Reviewer: 2
Comment 1: General comment: Statistical methods are appropriate. However, authors should check for publication bias to assess if studies with negative results (i.e. no difference between odds of CS for public/private insured women) were less likely to be included using a funnel plot (size of the study against measure of the effect). This is important as the the random effects meta-analysis assesses the average intervention (ie. private insurance) effect.
Response: To address this reviewer's comment, we included a funnel plot of adjusted ORs against their standard errors on a log scale in the web-appendix and found no evidence for small study effects. (Web Appendix 5)
We therefore included the following statements in the manuscript:
Methods section: "Finally, we visually inspected a funnel plot of adjusted ORs against their standard errors to address potential small study effects." (Page 7, paragraph 2 of the manuscript)
Results section: "Appendix 5 shows a funnel plot of adjusted ORs against their standard errors on a log scale; there was no evidence for small study effects." (Page 8, paragraph 2 of the manuscript)

Comment 2: p6.Line 50: awkaward phrasing " to combine overall OR". Perhaps "to estimate the pooled OR" is more clear
Response: We revised the sentence "We used standard inverse-variance random effects meta-analysis to combine overall OR" to "We used standard inverse-variance random effects meta-analysis to estimate the pooled OR". (Page 6, paragraph 4 of the manuscript)

Comment 3: p6. Line 57: other more stringent thresholds for interpreting tau2 are also used. Kotonpantelis et al. capture low, medium and large levels of heterogeneity using values of 0.01, 0.03 and 0.10 respectively (In https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3724681/pdf/pone.0069930.pdf).
Response: The interpretation of tau2 will depend on the scale used to estimate associations, in our case ln(OR). According to Spiegelhalter et al (Spiegelhalter DJ, Abrams KR, Myles JP. Bayesian approaches to clinical trials and health care evaluation. Chichester ; Hoboken, NJ: Wiley; 2004. p. 168), we interpret tau2 estimates with regard to the 95% reference range of ORs. Spiegelhalter et al suggest that it is unlikely that odds ratios vary by more than one order of magnitude, so an assumed 95% reference range from 1 to 10, for example, would result in tau=ln(10)/(2*1.96)=0.587, corresponding to a tau2 of 0.345, which in turn is the approximate tau2 to represent a high extent of heterogeneity according to our pre-specified criteria.
It is unclear to what scale Kotonpantelis et al are referring when specifying their values of tau2 of 0.01, 0.03 and 0.1 to represent low, moderate and high heterogeneity. A tau2 of 0.1 would correspond to a tau of 0.316, which in turn would result in a ratio of approximately 3.3 between lower and upper limit of the 95% reference range, and a tau2 of 0.03 would correspond to a tau of 0.173, which in turn would result in a ratio of approximately 2 between lower and upper limit of the 95% reference range. Our tau2 estimates were 0.006 for the main analysis of adjusted ORs and 0.011 for the analysis of crude ORs. Therefore, our conclusions would remain unaffected by a post-hoc change of our criteria.

VERSION 2 – REVIEW

REVIEWER	Marie Delnord INSERM UMR1153 Obstetrical, Perinatal and Pediatric Epidemiology Research Team-EPOPé Center for Epidemiology and Statistics Sorbonne Paris Cité- CRESS Paris Descartes University France
REVIEW RETURNED	08-Jun-2017

GENERAL COMMENTS	NA: Authors have addressed the points I raised in their revision. No further queries about the statistical methods and analyses used.