HEALTH ECONOMIC ASPECTS OF PREECLAMPSIA MANAGEMENT

Holger Stepan, MD

Chair & Professor, Department of Obstetrics

Leipzig University

International Workshop on Prenatal Screening

Berlin, 2 June 2018

The costs and the financial burden of preeclampsia are difficult or almost impossible to assess.

possible approaches:

costs for diagnostic / treatment per case / patient

costs saving caused by an improved management

cost saving caused by prevention or (improved) treatment

cost saving caused by reduced long-term consequences

usual way to look at economic aspects:

focus mainly on direct / immediate costs of a preeclamptic case

and do not cover the costs for long-term consequences
of **prematurity** (child) and **cardiovascular** disease (mother)

all available information are models or address particular economic aspects

all available information are strongly dependent on national health care system and the structure of financing
and reimbursement

economic effect depends on the incentive (i.e. hospitalisation)

Original Article

Estimating the Cost of Preeclampsia in the Healthcare System

Cross-Sectional Study Using Data From SCOPE Study (Screening for Pregnancy End Points)

Aimée Fox, Sheena McHugh, John Browne, Louise C. Kenny, Anthony Fitzgerald, Ali S. Khashan, Eugene Dempsey, Ciara Fahy, Ciaran O'Neill, Patricia M. Kearney

Table 4. Cost Estimates

Cost	Non-PE (Mean)	95% CI	PE (Mean)	95% CI	Differences Between Mean Costs	*P* Value*
Antepartum	€350	€219–€480	€793	€524–€1063	€443	0.0012
Peripartum	€433	€406–€459	€455	€410–€499	€22	0.40
Postpartum	€1669	€1184–€2154	€3995	€2388–€5602	€2326	<0.001
Total†	€2452	€1947–€2957	€5243	€3596–€6890	€2791	<0.001

CI indicates confidence interval; and PE, preeclampsia.

*P values are comparisons between groups with χ^2 or Student t test.

†Total maternity cost is a combination of antepartum, peripartum, and postpartum costs. All costs consist of maternal costs only, except for postpartum costs which include maternal and neonate costs, in terms of an neonatal intensive care unit (NICU) admission. As stated in Table 1, the cost of the infant's length of stay is included under the mother's length of stay. Total average cost including maternal costs (excluding NICU admission cost) is (non-PE: mean=€1970; 95% CI, €1808–€2133; PE: mean=€2785; 95% CI, €2476–€3093; P=<0.001). NICU admission costs are based on birthweight and length of stay in NICU. Because of outliers in length of stay in the NICU, there is consequently a large range in NICU costs. This is shown when estimating average NICU costs in isolation. Total average NICU admission (Table 2 for descriptive statistics) costs are as follows: non-PE: mean=€4998; 95% CI, €176–€9821; PE: mean=€8670; 95% CI, €4286–€13054; P=0.2416.

cohort n = 1774

PE n = 68 (3.8%)

vs. 171 controls

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Summary

The average cost of a pregnancy complicated by preeclampsia was €5243 per case compared with an uncomplicated pregnancy which was €2452. At a national level, we estimate that preeclampsia costs the Irish health system between €6.5 and €9.1 million per annum.

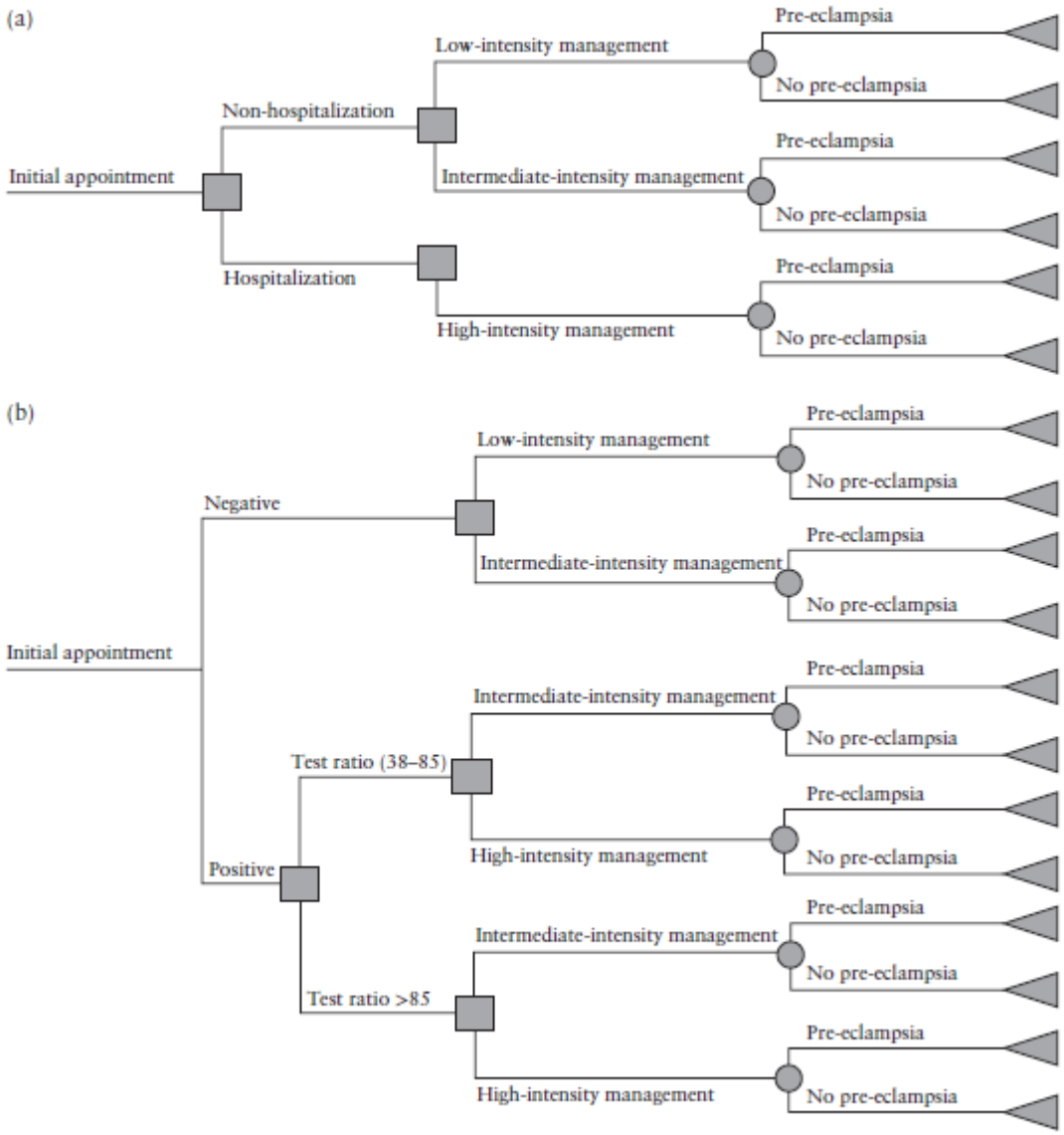
Ultrasound Obstet Gynecol 2016; 48: 765–771
Published online 8 November 2016 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/uog.15997.

sFlt-1/PlGF ratio test for pre-eclampsia: an economic assessment for the UK

M. VATISH*, T. STRUNZ-MCKENDRY†, M. HUND‡, D. ALLEGRANZA‡, C. WOLF‡ and C. SMARE§

**Nuffield Department of Obstetrics and Gynaecology, University of Oxford, Oxford, UK; †Roche Diagnostics Ltd, Burgess Hill, UK; ‡Roche Diagnostics International Ltd, Rotkreuz, Switzerland; §PAREXEL Access, PAREXEL, London, UK*

KEYWORDS: cost-effectiveness; diagnosis; economic; hospitalization; model; prediction; pre-eclampsia; sFlt-1/PlGF



‚no-test' scenario

‚test' scenario

Figure 1 Decision tree: (a) in the 'no-test' scenario and (b) in the 'test' scenario.

Vatish et al. UOG 2016; 48: 765-771.

Table 2 Cost analysis for introduction of serum fms-like tyrosine kinase-1/placental growth factor (sFlt-1/PlGF) ratio test in addition to current diagnostic procedures (test scenario) compared with costs of current diagnostic procedures only (no-test scenario), for guiding management of pre-eclampsia (PE) in a cohort of 1050 women with suspected PE from the PROGNOSIS study

Treatment	*No-test scenario cost (£)*	*Test scenario cost (£)*	*Difference (£)*
Initial appointment	445 673	445 673	0
sFlt-1/PlGF test	—	68 250	68 250
sFlt-1/PlGF retest	—	40 043	40 043
Management costs prior to PE for patients who develop PE	399 103	422 755	23 652
Low risk	25 629	25 506	−123
Intermediate risk	77 169	126 907	49 738
High risk	296 306	270 343	−25 963
PE management	616 337	609 049	−7288
Management costs for patients without PE	2 811 942	2 326 603	−485 340
Low risk	304 432	351 135	46 703
Intermediate risk	916 656	1 273 271	356 616
High risk	1 590 855	702 196	−888 658
Use of corticosteroids	2737	2237	−500
Unplanned re-attendance at hospital	69 591	69 591	—
Total per cohort	4 345 382	3 984 200	−361 182
Total per patient	4138	3794	−344

Slight discrepancies between numbers and totals are due to rounding.

Vatish et al. UOG 2016; 48: 765-771.

Use of the sFlt-1/PlGF ratio and healthcare costs Economic evaluation for the UK

Target patient population: women with suspected PE

	No test scenario	Test scenario
Women hospitalised	379	166
Costs per patient	GBP 4,138	GBP 3,794
Savings per patient		**-GBP 344**

Vatish et al. Ultrasound Obstet Gynecol 2016; 48: 765–771.

PLOS ONE

RESEARCH ARTICLE

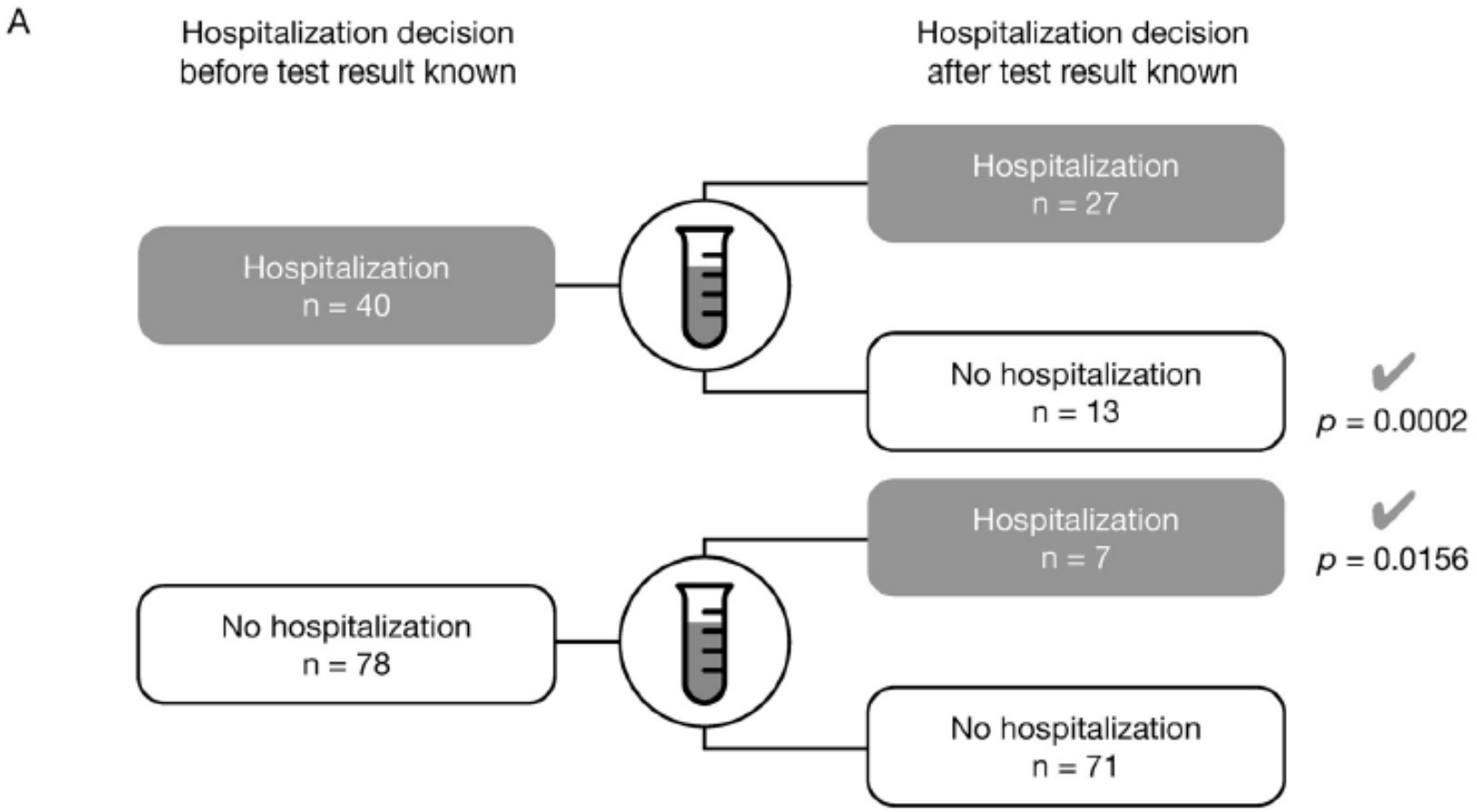
Influence of the sFlt-1/PlGF Ratio on Clinical Decision-Making in Women with Suspected Preeclampsia

Evelyn Klein[1], Dietmar Schlembach[2¤], Angela Ramoni[3], Elena Langer[4], Franz Bahlmann[5], Sabine Grill[1], Helene Schaffenrath[3], Reinhard van der Does[6], Diethelm Messinger[6], Wilma D. J. Verhagen-Kamerbeek[7], Manfred Reim[8], Martin Hund[7], Holger Stepan[4]*

1 Department of Gynecology and Obstetrics, Klinikum Rechts der Isar, TU München, Munich, Germany, **2** Dept. of Obstetrics, University Hospital, Jena, Germany, **3** Department of Obstetrics and Gynecology, University Hospital of Innsbruck, Innsbruck, Austria, **4** Department of Obstetrics, Leipzig University, Leipzig, Germany, **5** Department of Obstetrics, Bürgerhospital, Frankfurt, Germany, **6** IST GmbH, Mannheim, Germany, **7** Medical and Scientific Affairs, Roche Diagnostics International Ltd, Rotkreuz, Switzerland, **8** Medical and Scientific Affairs, Roche Diagnostics GmbH, Penzberg, Germany

¤ Current address: Vivantes Clinics Neukölln, Clinic of Obstetrics, Berlin, Germany
* Holger.Stepan@medizin.uni-leipzig.de

Klein et al. PLoS One. 2016 May 31;11(5)



The clinical use of a biomarker reduces hospitalization rate.

Klein et al. PLoS One. 2016 May 31;11(5)

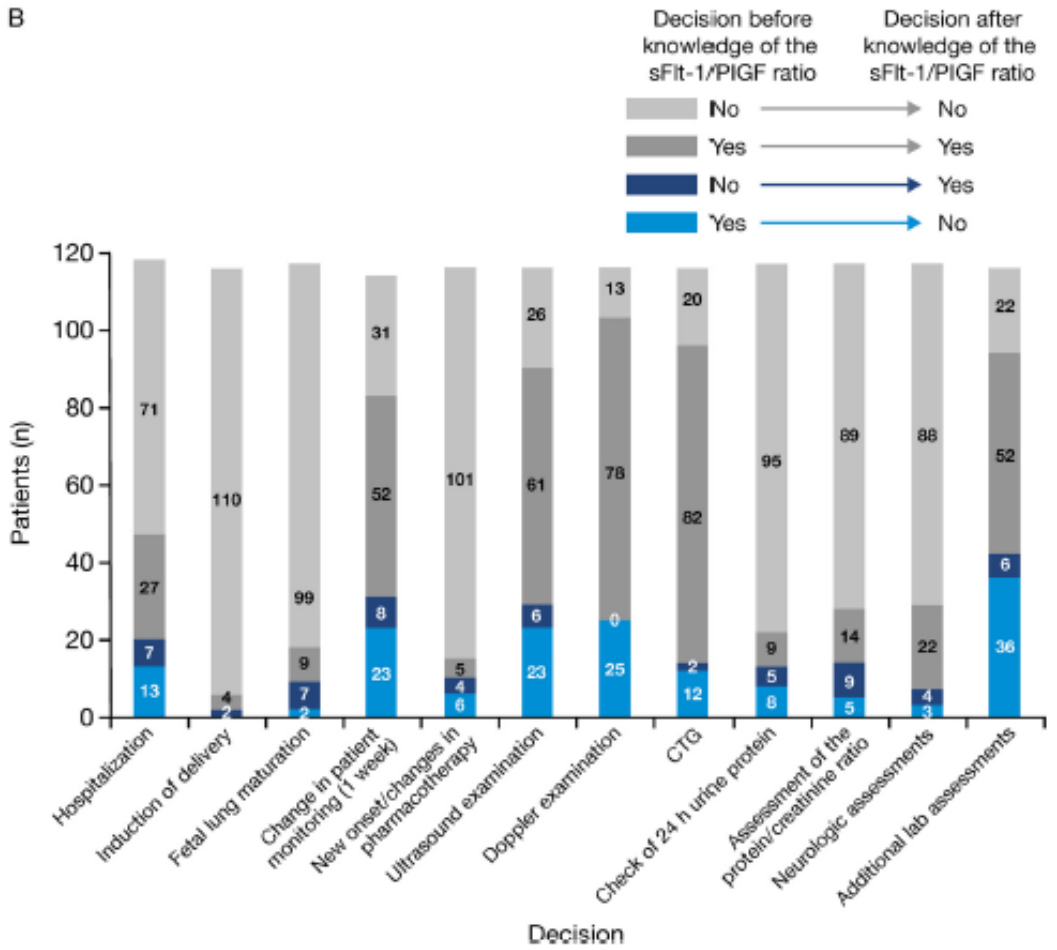


Fig 2. (A) Primary endpoint decisions on hospitalization changes based on the sFlt-1/PlGF result (per-protocol population, n = 118) and (B) summary of all endpoint decisions before and after knowledge of the sFlt-1/PlGF ratio (all changes were considered appropriate by the adjudicators) (per-protocol population, n = 118).

doi:10.1371/journal.pone.0156013.g002

The clinical use of a biomarker results in a „step down“ management.

Klein et al. PLoS One. 2016 May 31;11(5)

NICE economic evaluation of angiogenic assays health economic studies and models

Study	Model design	Country	Intervention	Comparator
Hadker, 2010[1]	Decision analytic model	UK	sFlt-1/PlGF ratio added to standard PE diagnostic practice during week 20 gestation	Standard UK clinical practice
Hadker, 2013[2]	Decision analytic model	Germany	sFlt-1/PlGF ratio added to standard PE diagnostic practice during week 20 gestation	Standard German clinical practice
Schnettler, 2013[3]	Decision analytic model	US	sFlt-1/PlGF ratio at less then 34 weeks of gestation	Standard US clinical practice
NICE economic model[4]	Decision tree model	UK	PlGF-based test used with standard clinical assessment in women with suspected PE presenting: • between gestation week 20 and 33 plus 6 days • between gestation weeks 34 to delivery	Standard UK clinical practice

1. Hadker, N., et al. (2010). *J Med Econ* 13, 728-737
2. Hadker, N., et al. (2013). *Hypertens Pregnancy* 32, 105-119
3. Schnettler, W.T., et al. (2013). *BJOG* 120, 1224-1232
4. NICE Diagnostics guidance Published: 11 May 2016 https://www.nice.org.uk/guidance/dg23

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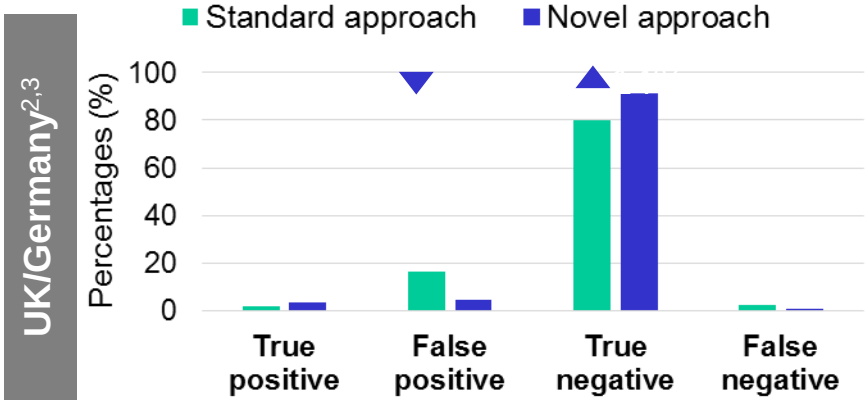
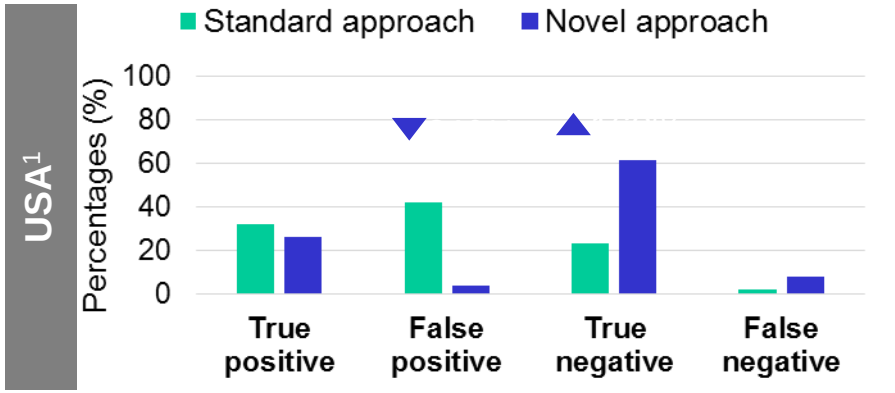


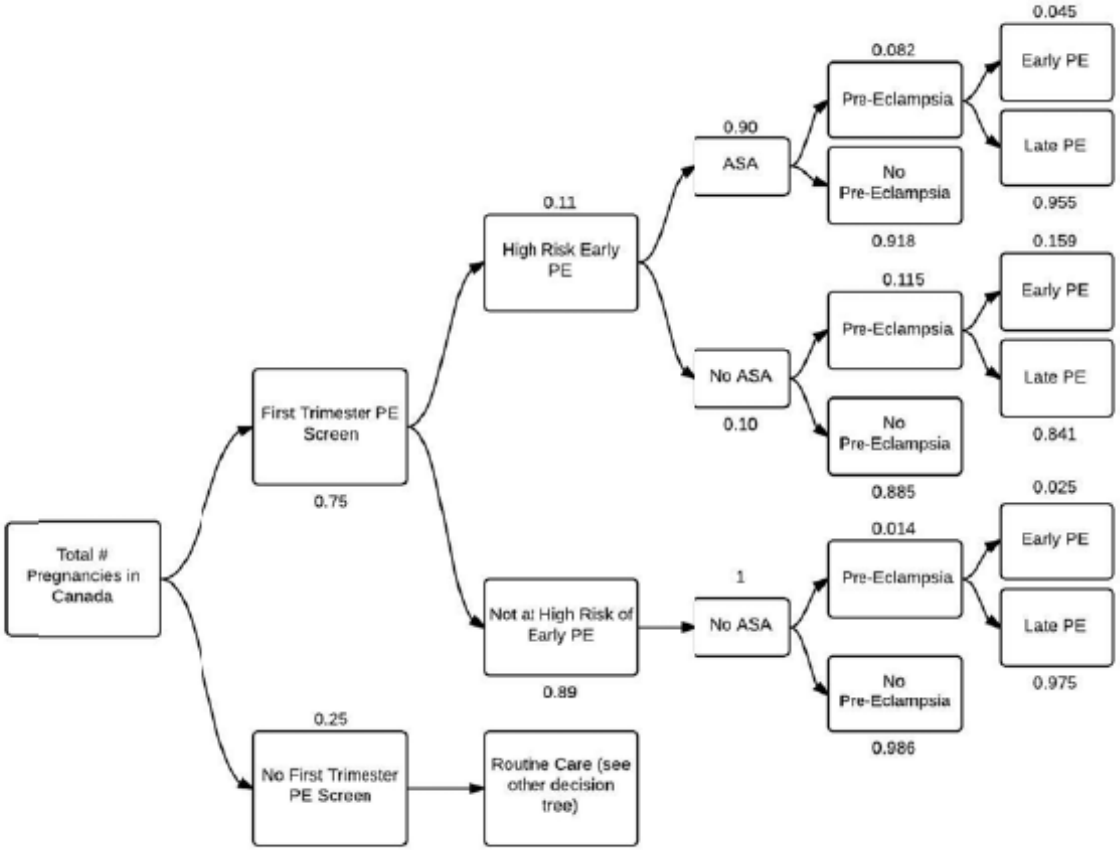


UK[1]	Germany[2]	USA[3,4]
With sFlt-1/PlGF ratio: False-positive reduction: **72%** True-negative increase: **14%**	**With sFlt-1/PlGF ratio:** False-positive reduction: **72%** True-negative increase: **14%**	**With sFlt-1/PlGF ratio:** False-positive reduction: **91%** True-negative increase: **63%**
Cost saving per patient: **GBP 945**	Cost saving per patient: **EUR 637**	Cost saving per patient: **USD 1,215**
Country saving per year: **GBP 730M**	Country saving per year: **EUR 436M**	Country saving per year: **USD 4.8B**

1. Hadker et al (2010). *J Med Econ* 13:728-737; 2. Hadker et al (2013). *Hypertens Pregnancy* 32:105-119; 3. Schnettler et al (2013). *BJOG* 120:1224-32; 4. CDC (2013). Births and natality. Available at http://www.cdc.gov/nchs/fastats/births.htm Last accessed June 2015

The cost-effectiveness of first trimester screening and early preventative use of aspirin in women at high risk of early onset pre-eclampsia

Figure 2. Decision tree for first trimester screening model with probabilities



Ortved et al. UOG in press

The cost-effectiveness of first trimester screening and early preventative use of aspirin in women at high risk of early onset pre-eclampsia

Short Title: Cost of pre-eclampsia

Authors: Dayne Ortved[1*], T Lee-Ann Hawkins[2], Jo-Ann Johnson[2], Jon Hyett[3], Amy Metcalfe[2]

Table 2 Probability associated with nodes of the tree diagram based on theoretical first trimester screening program

Node	*Probability*
Women who present for T1 screen*	0.75
High risk for PE by T1 screen[13]	0.11
ASA use in high risk pregnancy [13]	0.90
PE development high risk on ASA[13]	0.082
• Early PE development on ASA[13]	0.045
PE development high risk no ASA[13]	0.115
• Early PE development high risk no ASA[13]	0.159
PE development not at high risk [12]	0.014
• Early PE development not high risk[12]	0.025

*Expert opinion

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Table 3 Cost per pregnancy

Health Care Service	*Cost (CAD$)*
Average vaginal delivery*	3492.53
Caesarean Section*	5737.53
Average vaginal & Cesarean*	4615.03
First Trimester Screen †	572.21
Uterine Artery Doppler¶	41.63
Placental Growth Factor (PlGF) test [26]	55.00
Late pre-eclampsia management (Average Vaginal & Cesarean)[20]	6027.23
Early pre-eclampsia management (<34 weeks) *,[20]	13268.21
Aspirin (81 mg daily 12-40 weeks)§	24.50
Aspirin (162 mg daily for 12-40 weeks)§	49.00

*Canadian Institute for Health Information with corrected inflation to 2016 † Institute for Health Research Alberta ¶Alberta Health Services data § Rexall Pharmacy Canada

387.516 birth / year

cost saving

14,386,981.80 CAD

Ortved et al. UOG in press

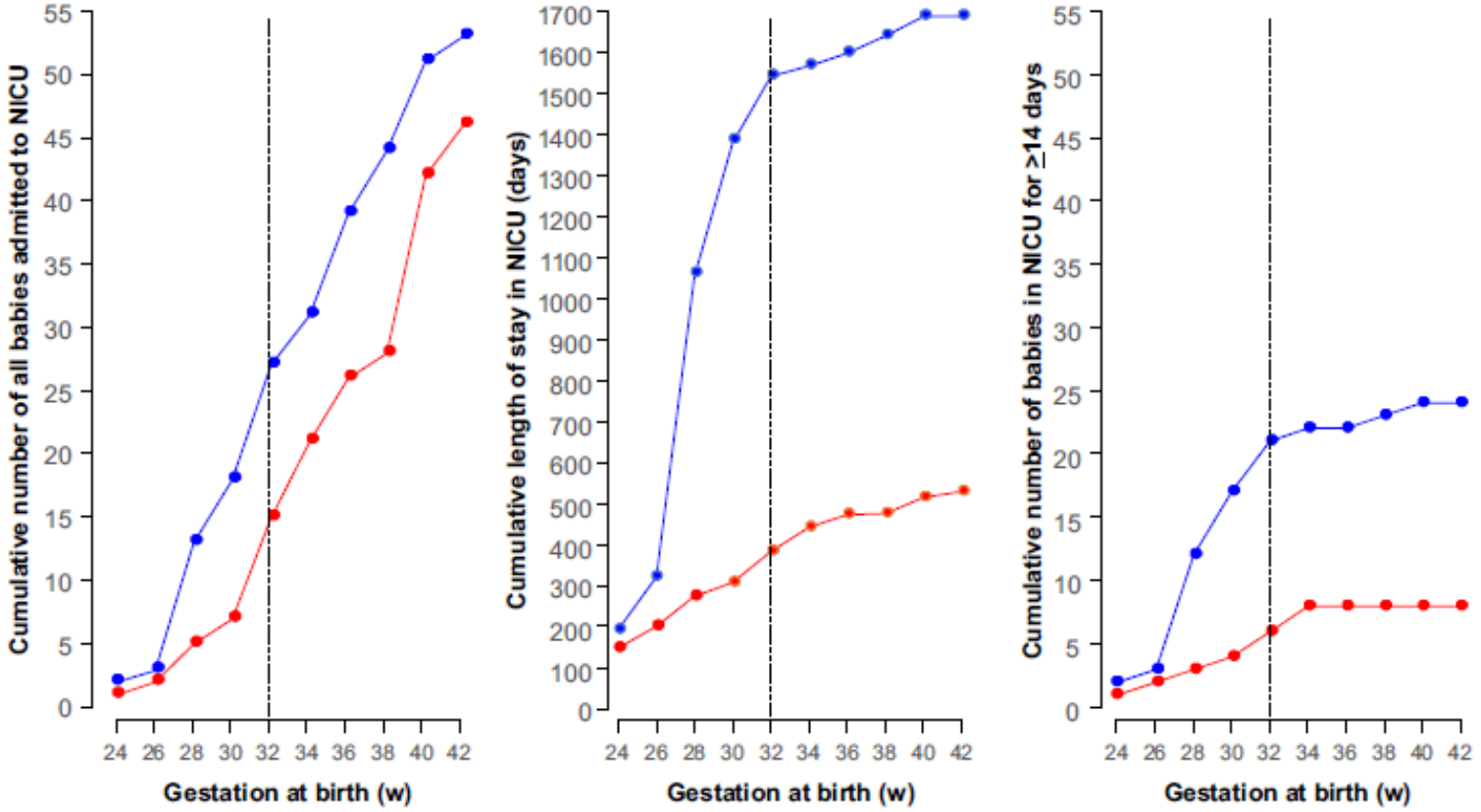
Original Research ajog.org

OBSTETRICS

Aspirin for Evidence-Based Preeclampsia Prevention trial: effect of aspirin on length of stay in the neonatal intensive care unit

David Wright, PhD; Daniel L. Rolnik, MD; Argyro Syngelaki, PhD; Catalina de Paco Matallana, MD; Mirian Machuca, MD; Mercedes de Alvarado, MD; Sofia Mastrodima, MD; Min Yi Tan, MD; Siobhan Shearing, RM; Nicola Persico, MD; Jacques C. Jani, MD; Walter Plasencia, MD; George Papaioannou, MD; Francisca S. Molina, MD; Liona C. Poon, MD; Kypros H. Nicolaides, MD

FIGURE
Admission to neonatal intensive care unit in the trial groups



Cumulative number of babies admitted to neonatal intensive care unit (NICU) according to gestational age at birth for placebo (blue circles) and aspirin (red circles) groups. Cumulative NICU: number of all babies admitted (left), length of stay (center), and number of babies with length of stay >14 days.

Wright et al. Secondary analysis of ASPRE trial. Am J Obstet Gynecol 2018.

AJOG at a Glance

Why was this study conducted?

The study was conducted in women at high risk of preeclampsia to examine the effect of prophylactic use of aspirin during pregnancy on length of stay in the neonatal intensive care unit (NICU).

Key findings

Prophylactic use of aspirin reduces the length of stay in NICU by about 70%, mainly due to a decrease in the rate of births at <32 weeks' gestation because of prevention of early preeclampsia.

What does this add to what is known?

In women at high risk of preeclampsia, prophylactic use of aspirin reduces substantially both the risk of preterm preeclampsia and length of stay in NICU.

Short-term costs of preeclampsia to the United States health care system

Warren Stevens, PhD; Tiffany Shih, PhD; Devin Incerti, PhD; Thanh G. N. Ton, MPH, PhD; Henry C. Lee, MD; Desi Peneva, MS; George A. Macones, MD; Baha M. Sibai, MD; Anupam B. Jena, MD, PhD

BACKGROUND: Preeclampsia is a leading cause of maternal morbidity and mortality and adverse neonatal outcomes. Little is known about the extent of the health and cost burden of preeclampsia in the United States.

OBJECTIVE: This study sought to quantify the annual epidemiological and health care cost burden of preeclampsia to both mothers and infants in the United States in 2012.

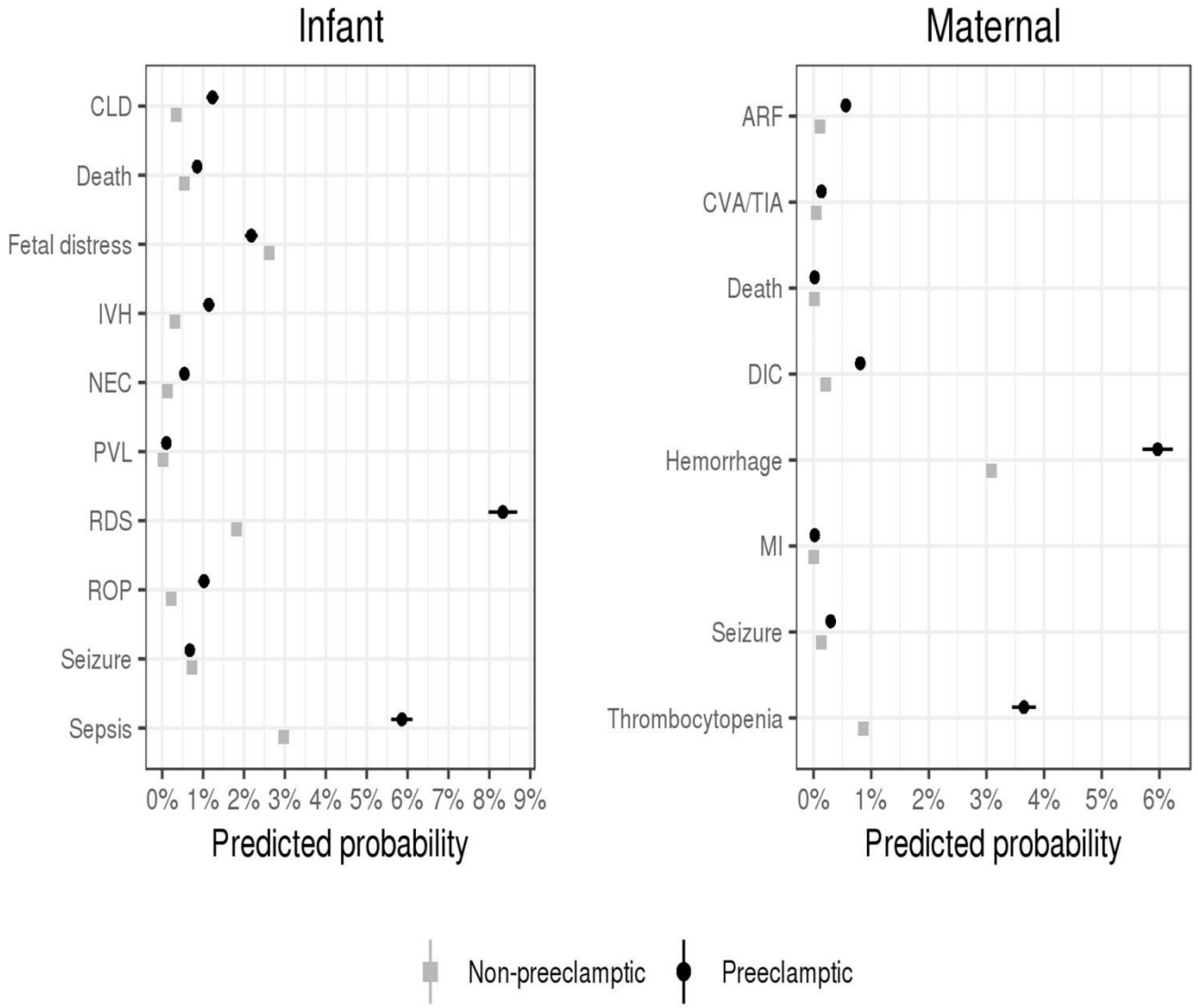
STUDY DESIGN: We used epidemiological and econometric methods to assess the annual cost of preeclampsia in the United States using a combination of population-based and administrative data sets: the National Center for Health Statistics Vital Statistics on Births, the California Perinatal Quality Care Collaborative Databases, the US Health Care Cost and Utilization Project database, and a commercial claims data set.

RESULTS: Preeclampsia increased the probability of an adverse event from 4.6% to 10.1% for mothers and from 7.8% to 15.4% for infants while lowering gestational age by 1.7 weeks ($P < .001$). Overall, the total cost burden of preeclampsia during the first 12 months after birth was $1.03 billion for mothers and $1.15 billion for infants. The cost burden per infant is dependent on gestational age, ranging from $150,000 at 26 weeks gestational age to $1311 at 36 weeks gestational age.

CONCLUSION: In 2012, the cost of preeclampsia within the first 12 months of delivery was $2.18 billion in the United States ($1.03 billion for mothers and $1.15 billion for infants), and was disproportionately borne by births of low gestational age.

Key words: health care cost burden, hospital admission, maternal morbidity, maternal mortality, perinatal morbidity, preeclampsia, preterm birth

Predicted Probability of Adverse Outcomes



Stevens et al. Am J Obstet Gynecol 2017

TABLE 6

Estimated unit and total health care cost for preeclampsia patients in the United States, by gestational age at birth (2012) using California Office of Statewide Health Planning and Development and commercial claims data

Costs	<28 wks (3604)	28-33 wks (23,624)	34-36 wks (41,856)	37 wks or longer (87,596)	All (156,680)
Maternal cost per birth	$29,131	$24,063	$19,692	$17,021	$19,075
Infant cost per birth	$282,570	$59,803	$11,112	$6013	$21,847
Combined cost per birth	$311,701	$83,866	$30,804	$23,035	$40,922
Total health care cost	$1.2 billion	$2.0 billion	$1.3 billion	$2.0 billion	$6.4 billion
Total cost because of infant cost, %	91%	71%	36%	26%	

Stevens. Short-term costs of preeclampsia in the US. Am J Obstet Gynecol 2017.

Stevens et al. Am J Obstet Gynecol 2017

TABLE 1
Estimates of lifetime QALYs lost by outcome

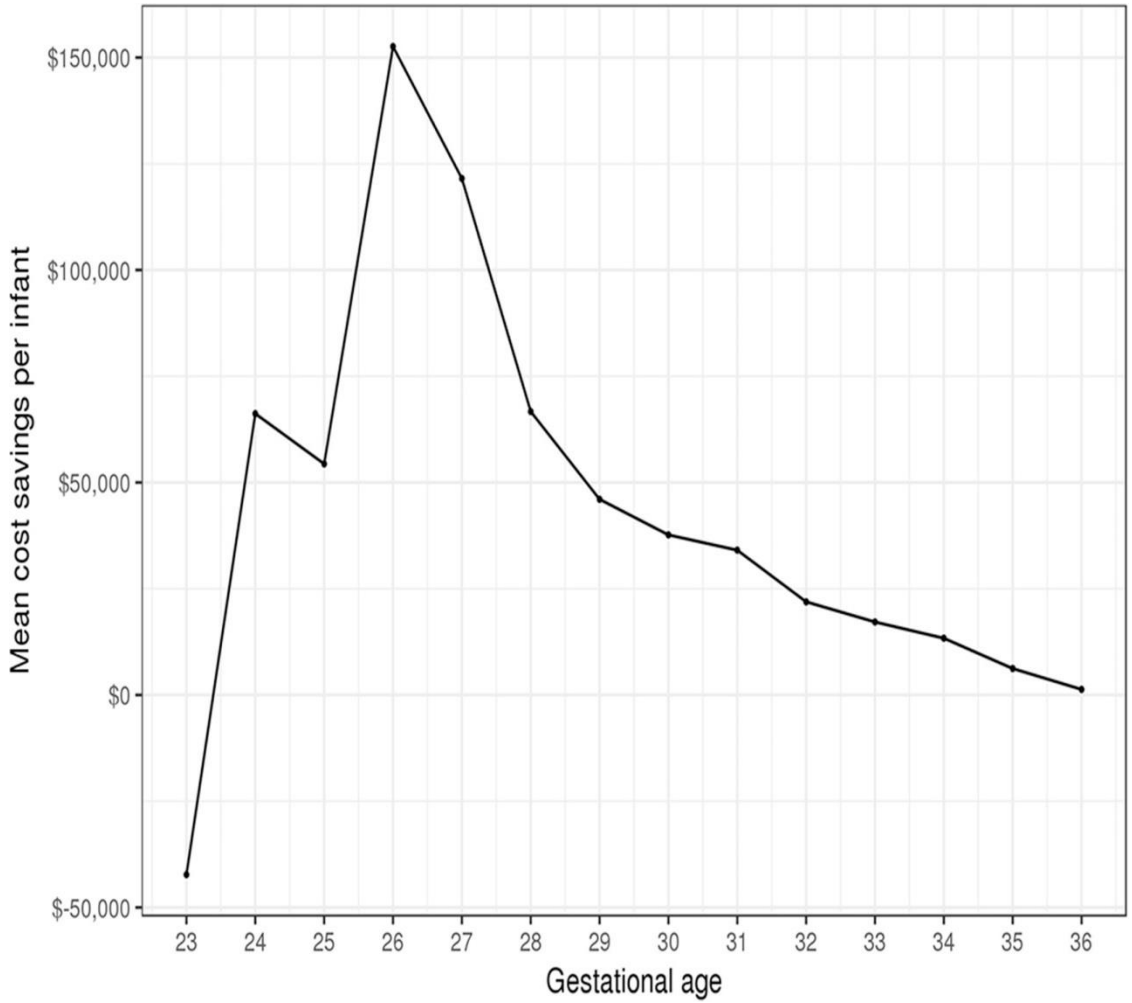
Outcome	Lifetime discounted QALYs	Net QALYs lost	Cases in preeclamptic pregnancies	QALYs lost	Social burden
Healthy infant	30.9				
NEC	22	8.9	976	8686	$1303 m
ROP	21.3	9.6	1918	18,413	$2762 m
BPD	26	4.9	2189	10,726	$1609 m
IVH / PVL	27	3.9	2456	9578	$1437 m
Death	0	30.9	2407	74,376	$11,156 m
Total				121,780	$18,267 m

Notes: Social burden estimate values a QALY at $150,000. NEC = necrotizing enterocolitis, ROP = retinopathy of prematurity, IVH = intraventricular hemorrhage, PVL = cystic periventricular leukomalacia, BPD = bronchopulmonary dysplasia.

Stevens. Short-term costs of preeclampsia in the US. Am J Obstet Gynecol 2017.

Stevens et al. Am J Obstet Gynecol 2017

FIGURE 3
Mean decrease in costs for infants born 2 weeks later



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Stevens et al. Am J Obstet Gynecol 2017

Summary

Improved screening and risk assessment has the potential to reduce costs through focussing ressources at patients at risk.

A reliable „ruling out“ and reducing the number of „false-positive“ cases will avoid unnecessary medical measures and intervention.

Summary

Improved screening and risk assessment has the potential to reduce costs through focussing ressources at patients at risk.

A reliable „ruling out“ and reducing the number of false-positive cases will avoid unnecessary medical measures and intervention.

However

Only an effective prevention (or even treatment) will reduce the tremendous costs of the long-term consequences of preeclampsia.

Thank you !