

# Regional *Practice* and *Outcome* *Differences*

## between 2 Neonatal Networks

Mark Adams

PhD Candidate Epidemiology, Biostatistics and Prevention  
Institute

SwissNeoNet Network Coordinator

Department of Neonatology, University Hospital Zurich

# Aims

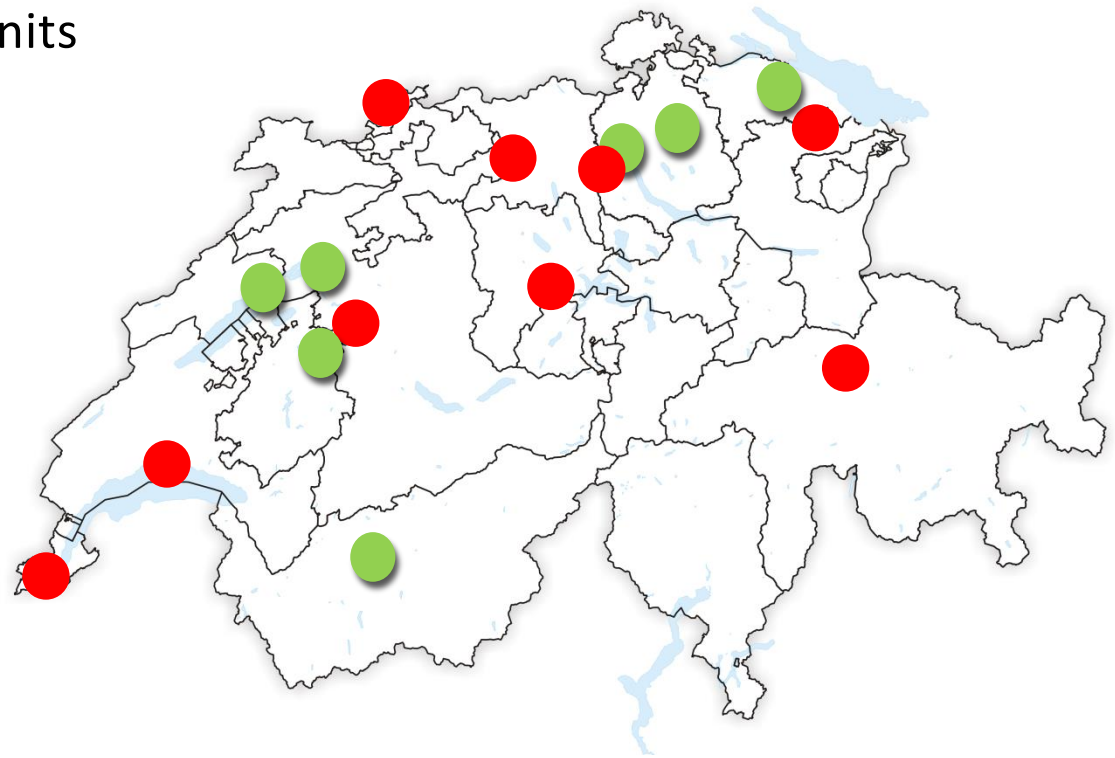
- Comparison of Swiss Neonatal Network (SNN) & US members of Vermont Oxford Network (US-VON)
- Very low birth weight infants (501-1500 g, VLBW).
- Relationship of adverse outcome – key practices
  - Obstetrical
  - Delivery room
  - Neonatal

# Background

- Practices based on evidence:
  - RCTs, systematic reviews, neonatal cochrane database
- Translation of new evidence -> practice
  - Variability in translation
  - Duration of implementing
- We have >20 years of documenting outcome and practice

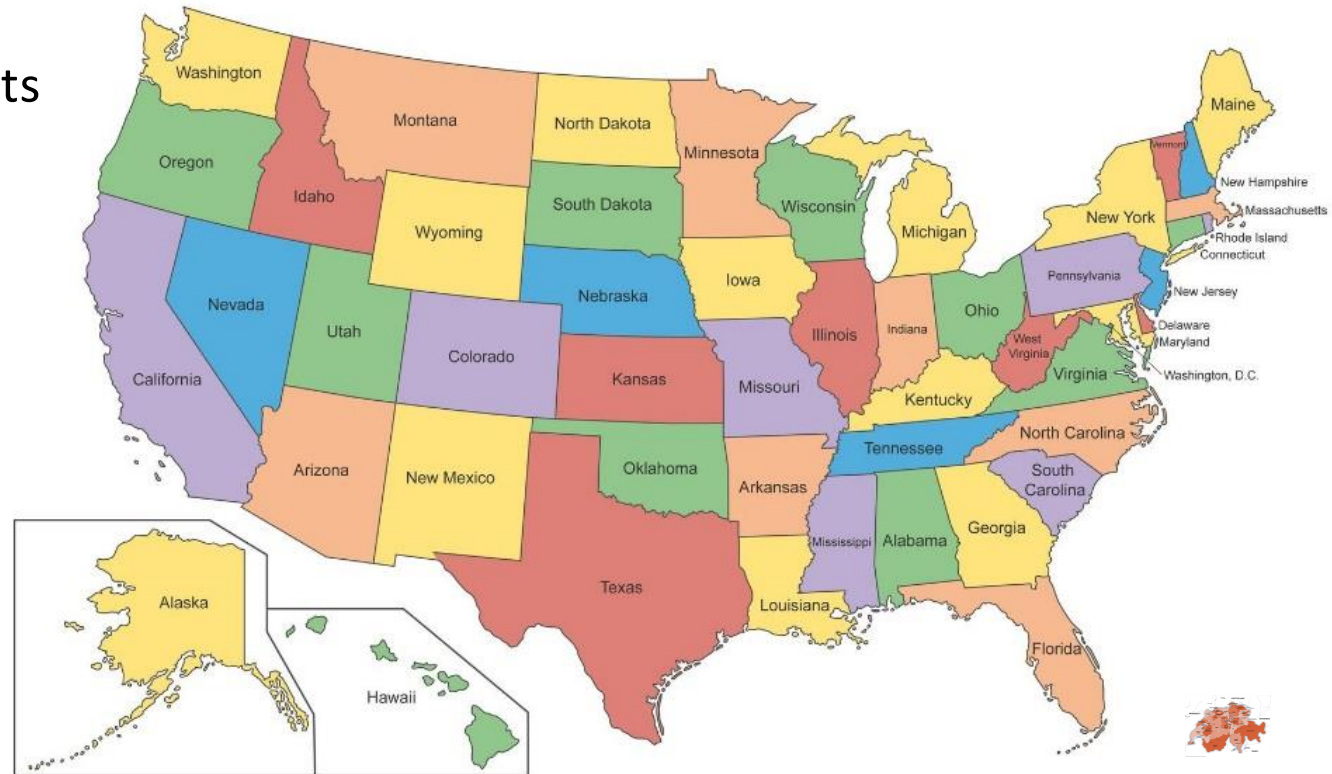
# SwissNeoNet (SNN)

- 9 Neonatal Intensive Care Units
- 7 Step-down units



# Vermont Oxford Network (US-VON)

- 557 Neonatal Intensive Care Units
- 139 Step-down units



# Data quality 2012 - 2014

## US-VON

- 84% Population based
- Clear data definition
- Challenge until complete

## SNN

- 95% Population based
- Same data definitions
- Modelled on VON

## Patient level baseline characteristics

Patient characteristics		US-VON	SNN
Infants 501-1500g		123689	2209
Gestational age (sd)		28.6 (2.9)	29.2 (2.9)
Small for gestational age		21.4%	27.7%
Sex male		50.7%	50.7%
Multiple birth (i.e. twins, triplets)		26.9%	34.3%
Major Malformations		5.0%	4.4%
Prenatal care		96.2%	100%
Ethnicity	asian	4.4%	3.2%
	black	29.9%	3.7%
	white	55.0%	92.9%
	other	10.5%	0.2%

# Unit level baseline characteristics

Distribution of		US-VON	SNN
N (units / infants 501-1500g)		696	13
Mean total admissions per year (sd)		514.4 (328.2)	440.1 (212.2)
Hospital owner	Government	8.2%	92.3%
	Non-Profit	74.8%	7.7%
	Investor	17.0%	0.0%
Neonatal Unit Type	Step-down	41.7%	30.8%
	Intensive Care	42.7%	38.5%
	IC + cardiac surgery	15.5%	30.8%
Pediatric resident in NICU		32.7%	100.0%
Neonatology fellow in NICU		20.7%	92.3%



# Outcome comparison

Outcome	Units	Proportions all infants	Odds ratios (95% CI)
			Adjusted OR
<b>Death or major morbidity</b>	US-VON	<b>46.9%</b>	<b>0.40</b> (0.35 to 0.46)
	SNN	<b>33.7%</b>	
<b>Any mortality</b>	US-VON	<b>11.0%</b>	<b>1.33</b> (1.11 to 1.60)
	SNN	<b>12.3%</b>	

## Different approach <25 weeks gestation

- Mortality SNN < 25w GA: 51.4% vs. 17.6% at US-VON
- Guidelines (2011):
  - 22w: a priori palliative care
  - 23w: palliative care with possibility of intensive care
  - 24w: intensive care with possibility of palliative care
- Swiss study 2012-2015: Decision-making in the DR was based almost exclusively on GA (Berger et al., BMJ 2017)

# Propensity score matching

- 2 equal sized groups matched on major confounders.
  - 1591 datasets each, matched for propensity score
- Death / major morbidity Swiss vs. US:
  - $OR_{\text{propensity score}} = 0.54$  (95% CI: 0.47-0.62)
  - $OR_{\text{total}} = 0.40$  (95% CI: 0.35-0.46)

# Sensitivity analysis

- Restriction to 25 – 29 gestational weeks
  - No major difference in perinatal activity!
- Death / major morbidity Swiss vs. US:
  - $OR_{\text{restricted}} = 0.40$  (95% CI: 0.34-0.47)
  - $OR_{\text{total}} = 0.40$  (95% CI: 0.35-0.46)

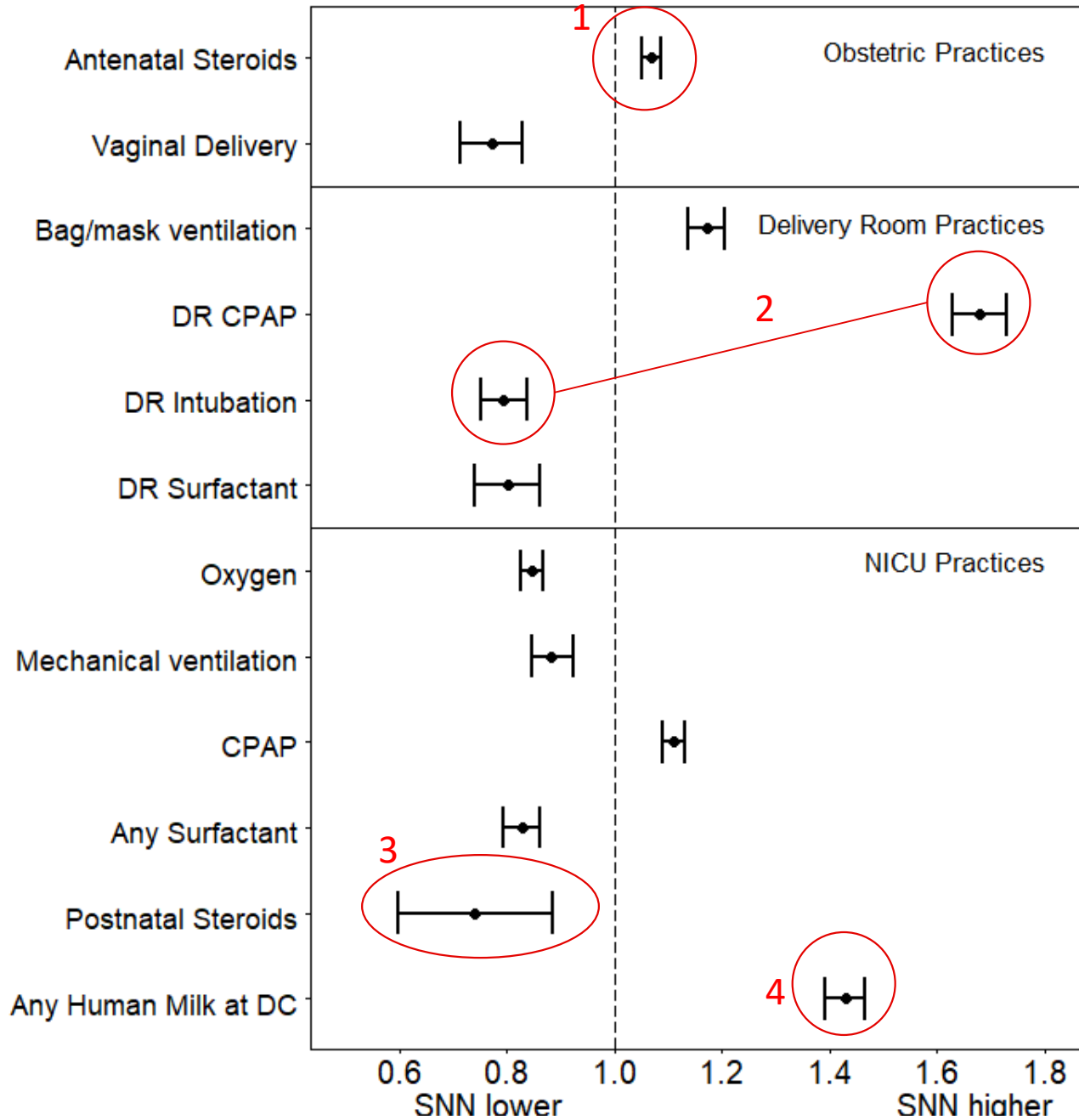
# Factors influencing outcome

- Prenatal meta-level factors:
  - Socio-economic factors: Switzerland has diversity
  - Health care: 96% of US mothers have prenatal care
  - Racial diversity: adjusted for

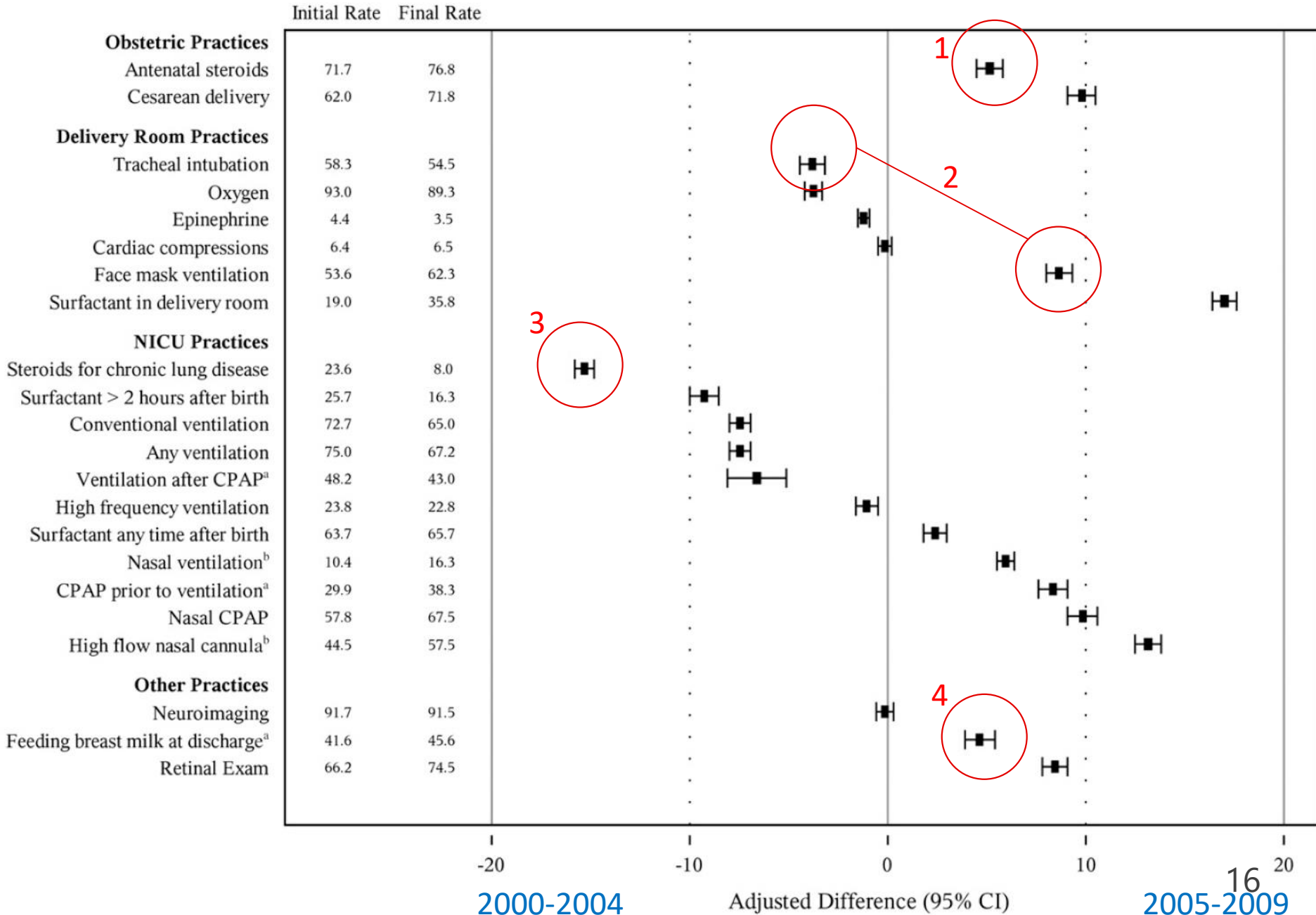
# Evidence based factors influencing outcome

- Perinatal factors
  - Antenatal steroids
- Delivery room:
  - Non-invasive respiratory support
- NICU:
  - Postnatal steroids
  - Human milk feeding

# Practice differences Swiss versus US-VON units



# Same pattern in Vermont Oxford Network over time





# Limitations

- Possible residual confounding
- Incomplete network data
- Some missing data for ROP

# Summary & Conclusions

- Mortality ↑ in Switzerland:
  - Possibly due to strategy for infants < 25w GA
- Death or major morbidity: ↓ in Switzerland
  - Possibly driven by variations in evidence based practice

# Outlook

- Which practice differences have strongest effect on outcome?
  - Start with evidence based practices in delivery room
  - Include regional variability in US

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# Extra slides

# Propensity score matching

	Summary of balance for all data				Summary of balance for matched data			
	Means SNN	Means <u>US-VON</u>	SD US-VON	Mean Diff.	Means SNN	Means <u>US-VON</u>	SD US-VON	Mean Diff.
Distance	0.15	0.01	0.04	0.14	0.15	0.15	0.08	0.00
GA	28.70	28.36	2.80	0.35	28.70	28.73	2.88	-0.03
GA <sup>2</sup>	831.94	811.94	160.02	19.99	831.94	833.89	166.37	-1.95
SGA	0.24	0.19	0.39	0.05	0.24	0.24	0.43	0.00
Male sex	0.51	0.51	0.50	0.00	0.51	0.51	0.50	0.00
Multiple birth	0.35	0.27	0.44	0.08	0.35	0.34	0.48	0.00
Ethnicity White	0.93	0.55	0.50	0.38	0.93	0.93	0.26	0.00
Ethnicity Asian	0.03	0.04	0.21	-0.01	0.03	0.03	0.17	0.00
Ethnicity American Indians	0.00	0.01	0.10	-0.01	0.00	0.00	0.00	0.00
Ethnicity Pacific Islanders	0.00	0.00	0.07	0.00	0.00	0.00	0.05	0.00
Ethnicity other	0.00	0.09	0.29	-0.09	0.00	0.00	0.00	0.00
Hosp. owner non-profit	0.17	0.77	0.42	-0.59	0.17	0.17	0.38	0.00
<u>Hosp. owner investor</u>	0.00	0.10	0.30	-0.10	0.00	0.00	0.00	0.00
<u>Hosp. owner other</u>	0.00	0.03	0.18	-0.03	0.00	0.00	0.00	0.00

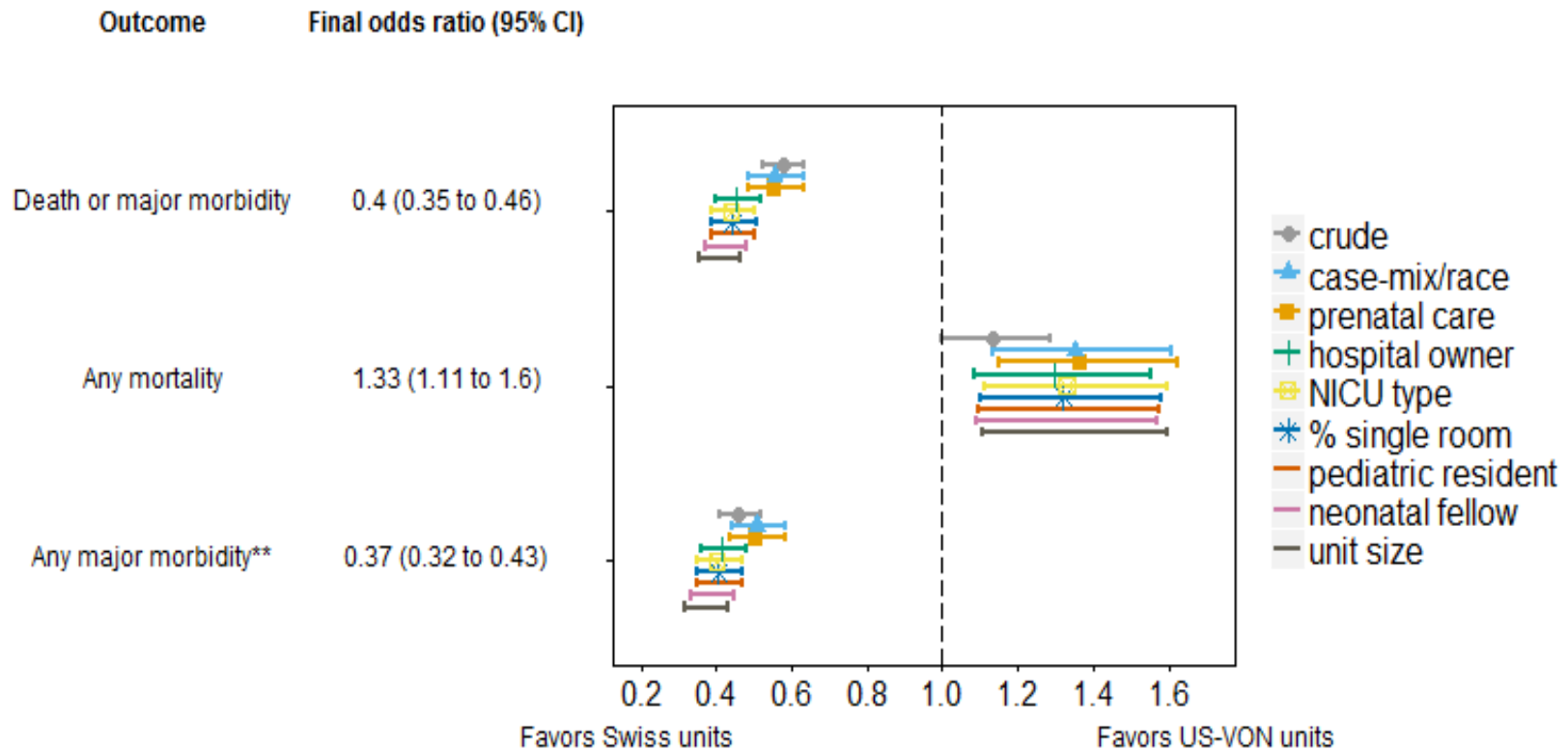
GA: gestational age; SGA: small for GA; Hosp.: Hospital.; Diff.: Difference

# Gestational age stratified results

Outcome	Units	Proportions						Final odds ratio (95% CI)
		Gestational age weeks					All infants	
		<25	25-26	27-28	29-31	>31		
Death or major morbidity*	US-VON	93.1%	71.7%	43.6%	24.1%	17.8%	46.9%	0.40 (0.35 to 0.46)
	SNN	90.8%	63.8%	32.7%	15.5%	9.0%	33.7%	
Any mortality*	US-VON	43.3%	14.6%	6.1%	3.4%	4.6%	11.0%	1.33 (1.11 to 1.60)
	SNN	68.5%	21.5%	7.5%	3.3%	2.5%	12.3%	
- Early mortality*	US-VON	17.6%	2.7%	1.3%	1.0%	1.8%	3.5%	2.07 (1.58 to 2.71)
	SNN	51.4%	4.3%	2.4%	1.0%	0.7%	6.0%	
- Late mortality †	US-VON	29.3%	12.0%	4.8%	2.3%	2.9%	7.7%	1.19 (0.96 to 1.48)
	SNN	33.7%	17.7%	5.2%	2.3%	1.8%	6.7%	
Any major morbidity ‡	US-VON	87.5%	66.5%	39.5%	20.8%	12.2%	39.1%	0.37 (0.32 to 0.43)
	SNN	70.7%	53.3%	26.8%	12.0%	6.0%	22.8%	
- NEC ‡	US-VON	9.3%	6.5%	4.4%	2.4%	1.3%	4.0%	0.32 (0.21 to 0.49)
	SNN	10.3%	1.8%	2.4%	0.9%	0.5%	1.5%	
- Late onset sepsis ‡	US-VON	30.1%	17.4%	8.7%	3.5%	1.5%	9.0%	0.79 (0.64 to 0.97)
	SNN	29.3%	20.8%	8.4%	2.8%	1.8%	7.1%	
- Severe IVH ‡	US-VON	20.8%	11.1%	4.8%	1.8%	0.8%	5.7%	0.74 (0.56 to 0.98)
	SNN	6.9%	8.8%	4.8%	1.9%	1.0%	3.5%	
- CLD ‡	US-VON	70.2%	51.1%	27.4%	11.7%	6.5%	25.9%	0.34 (0.28 to 0.40)
	SNN	49.1%	29.5%	15.0%	5.7%	2.0%	11.8%	
- Severe ROP ‡	US-VON	31.8%	12.4%	2.4%	0.6%	0.3%	6.1%	0.24 (0.15 to 0.37)
	SNN	13.8%	5.2%	0.0%	0.0%	0.0%	1.4%	

Denominators: \* all infants, † infants admitted, ‡ infants discharged home alive. NEC: necrotizing enterocolitis; Severe IVH: intra-/periventricular haemorrhage grade 3-4; CLD: chronic lung disease; Severe ROP: retinopathy of prematurity stages 3-4.

# Incremental risk adjustment





# Residual confounding

Item	US	Switzerland	Source
Tobacco consumption, % of population 15+ who are daily smokers	12.9%	20.4%	OECD health statistics records (2014)
Alcohol consumption, Liters per capita (age 15+)	8.9	9.5	OECD health statistics records (2014)
Obese population, self-reported, % of total population	29.5%	10.3%	OECD health statistics records (2014)