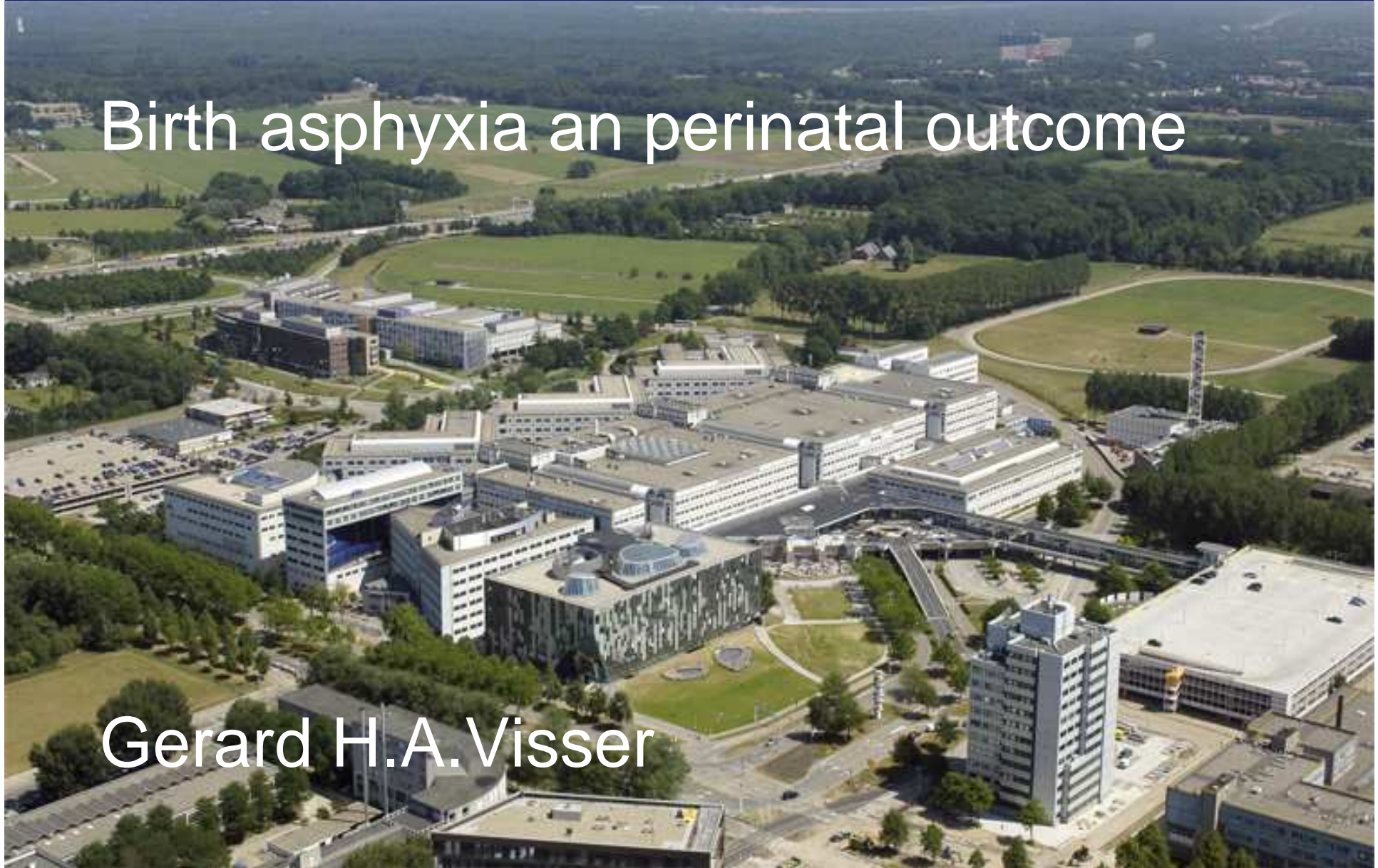


University Medical Center, Utrecht, the NL

Birth asphyxia an perinatal outcome

Gerard H.A. Visser

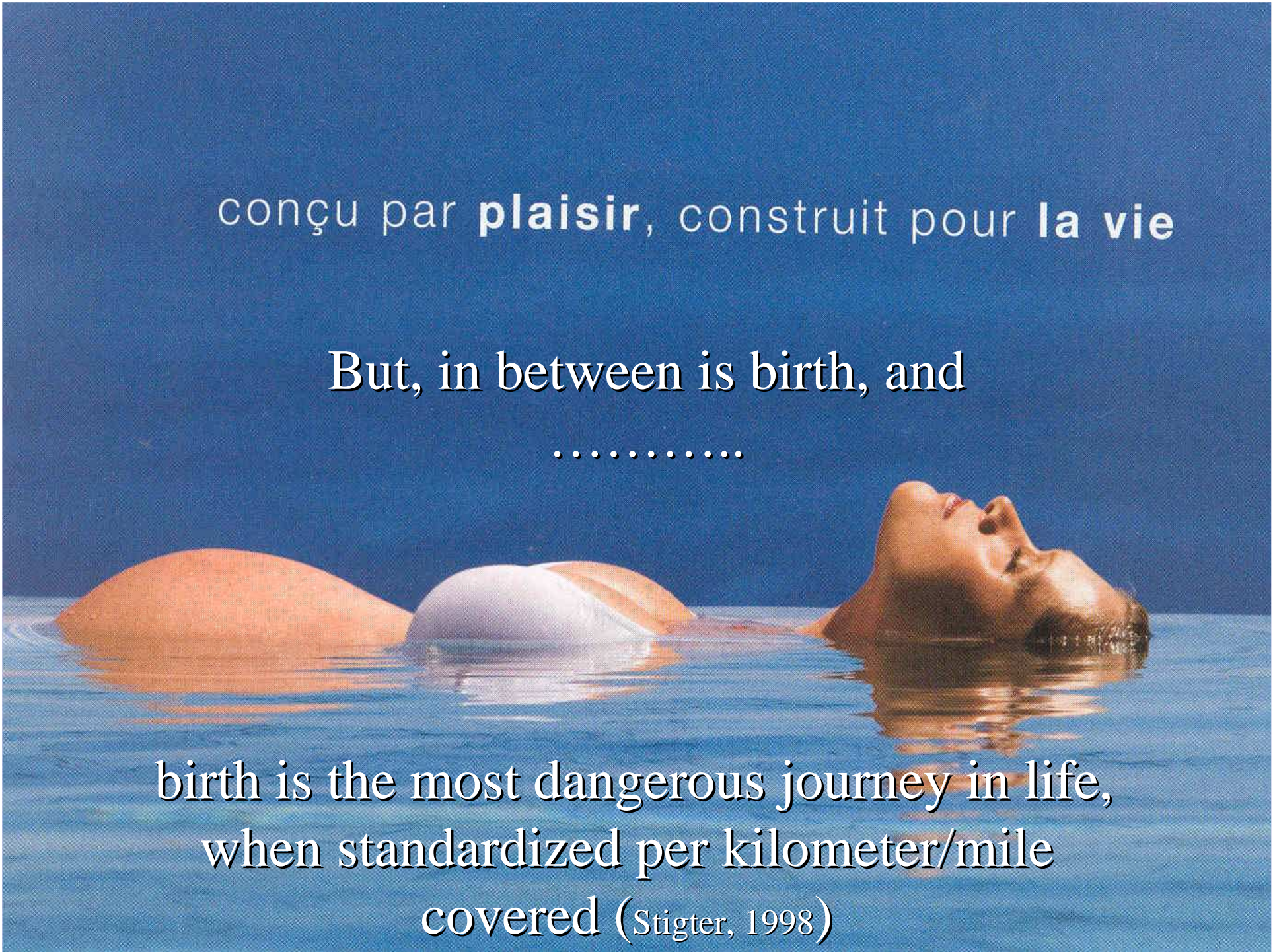


conçu par **plaisir**, construit pour **la vie**

But, in between is birth, and

.....

birth is the most dangerous journey in life,
when standardized per kilometer/mile
covered (Stigter, 1998)



Medico-legal implications?

- Yes
- NL:1992-2004, 36% of all medical-legal cases related to intrapartum CTG
- **Why???:**
- labour is directly followed by birth and a poor condition at birth and a poor outcome thereafter, is –therefore- directly associated with the process of labour and delivery

Impact of birth asphyxia

Parents of infants with behavioural problems more often report that their child was born in a poor condition.

However, at 4 years of age there is no relation between the parents idea about the infants' condition at birth (colour, breathing) and the facts obtained at birth.

(Touwen, 1981)

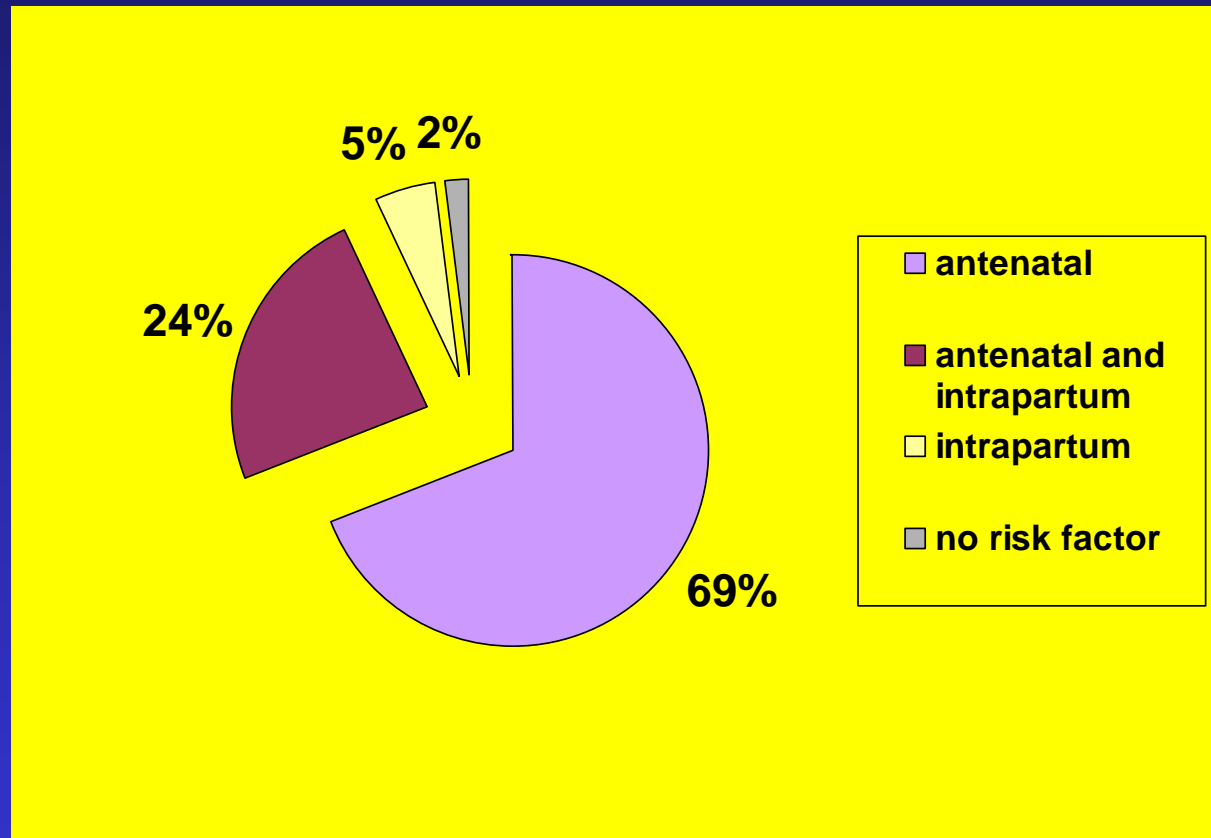
Neurological morbidity due to asphyxia in term infants

- Hagberg 28% (CP)
 - Van den Berg / Goldarber / Fee 15-25%
 - Freeman, Blair, Hughes 8-10% (CP)
 - Aarnoudse, Dennis, Vandenbussche < 5%
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-
- Definitions of asphyxia and of labour as opposed to the peripartum period and of short or long term outcome vary
 - And , equally important, clinical conditions may have varied

Neonatal encephalopathy in term infants



(Badawi et al, 1999)

Independent antenatal risk factors:

- low socio-economic status
- neurol. diseases in family
- pregn. after infertility treatment
- maternal thyroid disease
- pregn. induced hypertension
- IUGR
- antenatal haemorrhage
- viral infections during pregn.
- post term

(Badawi et al, 1999)

Birth asphyxia

- What do we mean:
 - low pH at birth
 - low Apgar score
 - or, both

Birth asphyxia & neonatal seizures in term infants

pH umb. art	n	neon. seizures
< 7.00	87	8 (9%)
	84*	9 (11%)
	95**	11 (12%)
7.00 – 7.04	95	4 (4%)
7.05 – 7.09	290	0
7.10 – 7.14	798	1 (0.1%)
7.15 – 7.19	2236	2 (0.1%)

(Goldarber, 1991; * Van den Berg, 1995, term + preterm;**Lavrijsen,2005)

Asphyxia and neonatal neurological complications in term infants

pH umb. art	N	Neurol. compl.
< 6.70	3	3
6.70 – 6.80	3	1
6.80 – 6.90	10	4
6.90 – 7.00	36	1

(v.d. Berg, 1995)

Asphyxia in term infants, Utrecht 1994-2002

	pH ua < 7.00	pH ua > 7.15
n	95	90
gest. age (mean)	40	39.7
birth weight (mean)	3314	3428
BD (mean)	19	7
Neon. seizures	11 (12%)	1 (1%)
Outcome:		
good	88 (93%)	84 (93%)
delayed neurodev.	5 (5%)	6 (7%)
neonatal death	2 (2%)	0
cerebral palsy	0	0

(Lavrijsen et al, 2005)

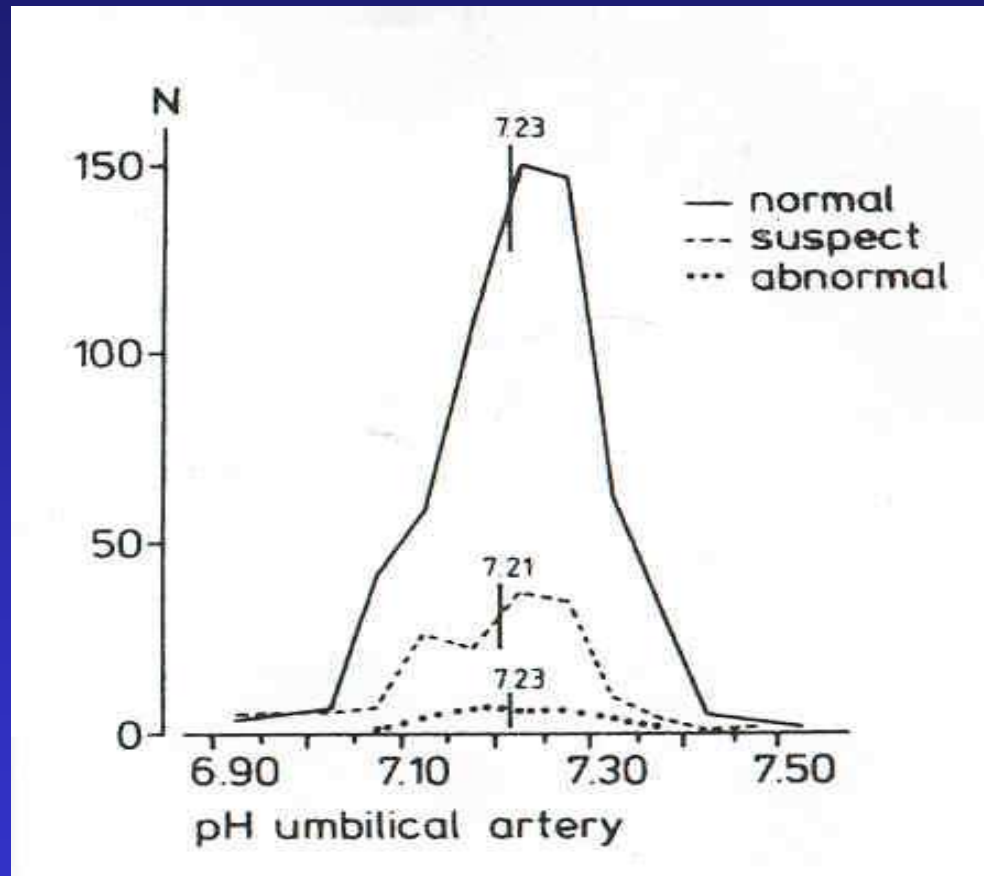
Asphyxia in preterm infants, Utrecht 1994-2002

	pH ua < 7.00	pH ua > 7.15
n	44	61
gest. age (mean)	31.4	32.6
birth weight (mean)	1580	1900
BD (mean)	21	6
Neon. seizures	9 (20%)	0
Outcome:		
good	30 (68%)	53 (79%)
delayed neurodev.	8 (18%)	9 (13%)
neonatal death	6 (14%)	3 (4%)
cerebral palsy	0	2 (3%)

(Lavrijsen et al, 2005)

pH umb. art & Neon. Neurol. Morbidity

805 AFD term infants



(Dijxhoorn et al, 1985)

So, intrapartum asphyxia (acidaemia)

- may kill
- but, the relationship with long term outcome is not always that clear
- why.....

Gr 3, P 2

Spontaneous labour 40 wks

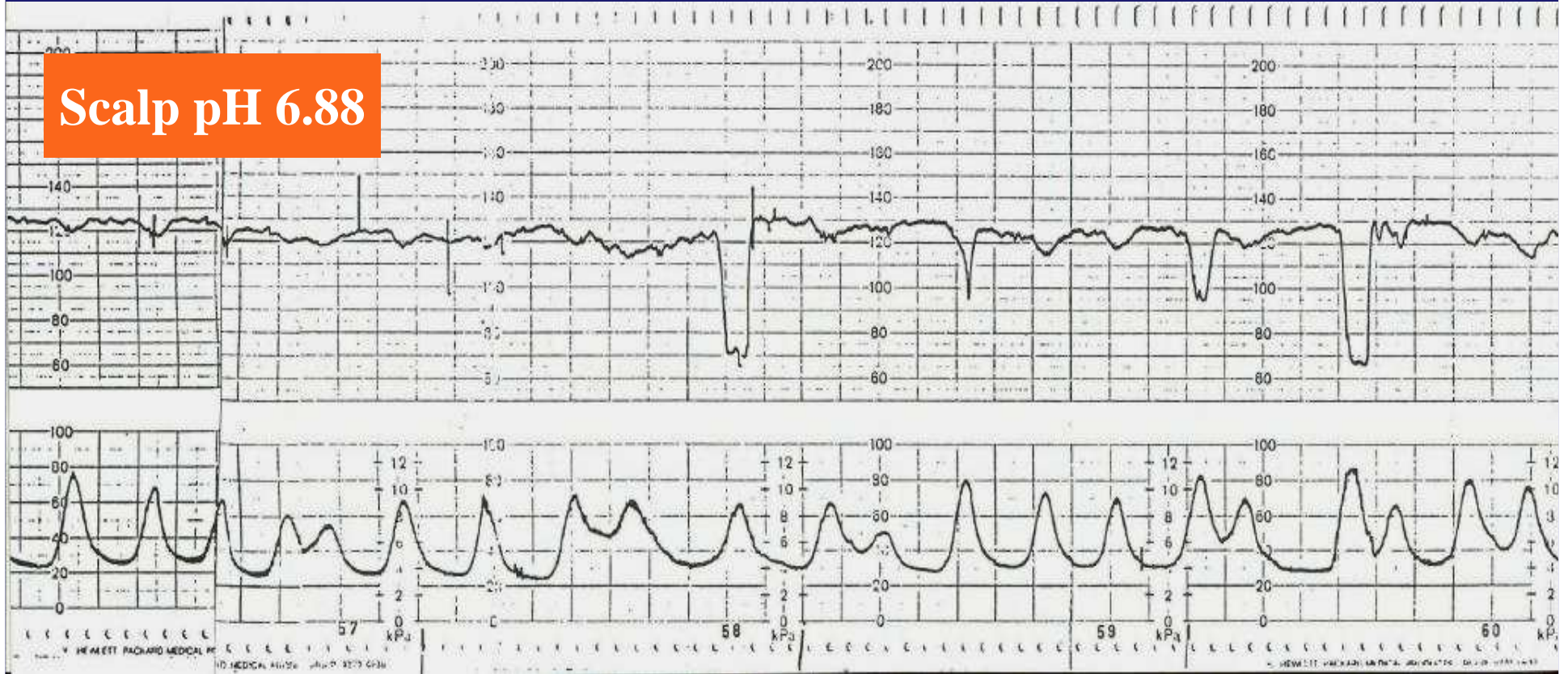
Normal FHR

Prolonged epidural procedure (1½ h)

No FHR monitoring

SRM, meconium

Scalp pH 6.88



Outcome

Forceps

♀ 3475 g, Apgar 3, 6, 7

pH ua 7.03

neonatal convulsions

handicap

Follow-up at age of 10 years

epilepsy

microcephaly

abnormal behaviour

Glucose levels first days after birth

Datum	Glucose - waarden		
16/9 - 9 ³⁰	10 ¹⁵ : <1,0	19/9	2 [~] : 1,2
	11 ⁼ : <1,0		3 ¹⁵ : 2,0
	12 ³⁰ : 3,5		6 ³⁰ : 1,3
	15 ³⁰ : <1,0		9 ^r : <1
	18 ⁼ : <1,0		19 ¹¹ : 2,1
	21 ³⁰ : 1,0		
	23 ³⁰ : 2,2		

(in mmol/l)

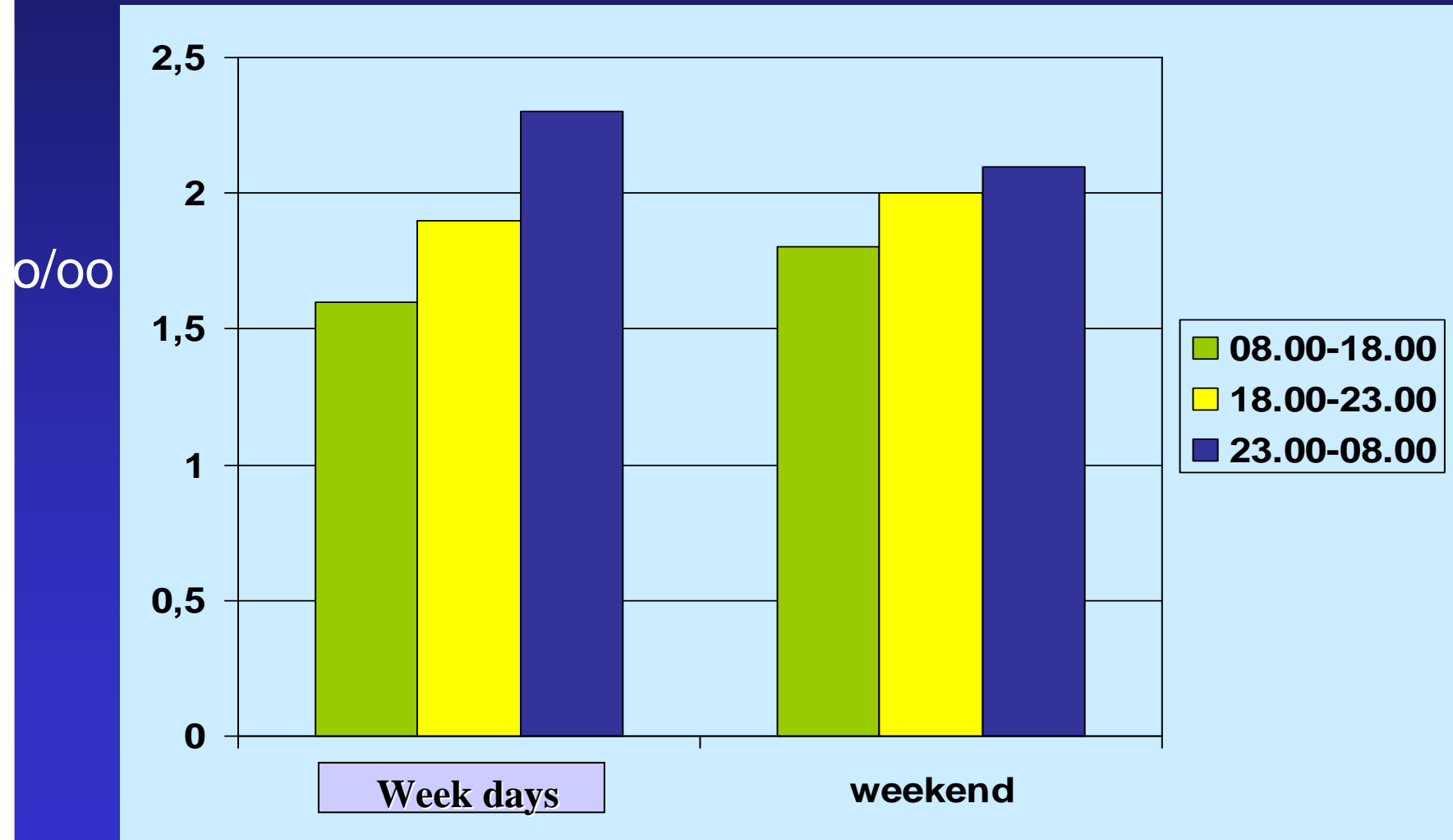
Thus,

**the incidence of handicaps following
birth asphyxia may well depend
strongly on **direct neonatal care,****

So, to improve outcome.....

Intrapartum and early neonatal deaths 2000-2006

N=520.350, without cong anomalies. Data: PRN



Outcome after birth asphyxia in term infants

	death	neurol. handicap
5 min. Apgar ≤ 3	5 %	5 %
pH ua < 7.00	8 %	1-3 %

(Nelson; Paneth; Van de Riet)

pH, Apgarscore & Neon. Neurol. Morbidity

Table 3. Relation between umbilical artery pH, 1-min Apgar score and the neonatal neurological condition

Umbilical artery pH	1-min Apgar score	n	Neonatal neurological diagnostic category			NNOS median
			Normal (%)	Suspect (%)	Abnormal (%)	
≤7.10	1-6	17	71	29	0	54.0
	7-10	69	77	22	1	55.3
	Total	86	76	23	1	55.2
7.11-7.19	1-6	21	67	23	10	53.9
	7-10	191	73	22	5	55.2
	Total	212	73	22	5	55.1
≥7.20	1-6	19	42	42	16	52.0
	7-10	486	80	17	3	55.4
	Total	505	79	18	3	55.3

NNOS, Neonatal neurological optimality score (Touwen *et al.* 1980).

(Dijxhoorn et al BJOG, 1986)

Low Apgar and pH

Babies with a low Apgar score and severe acidaemia at birth, have a better prognosis than those with a low Apgar score only

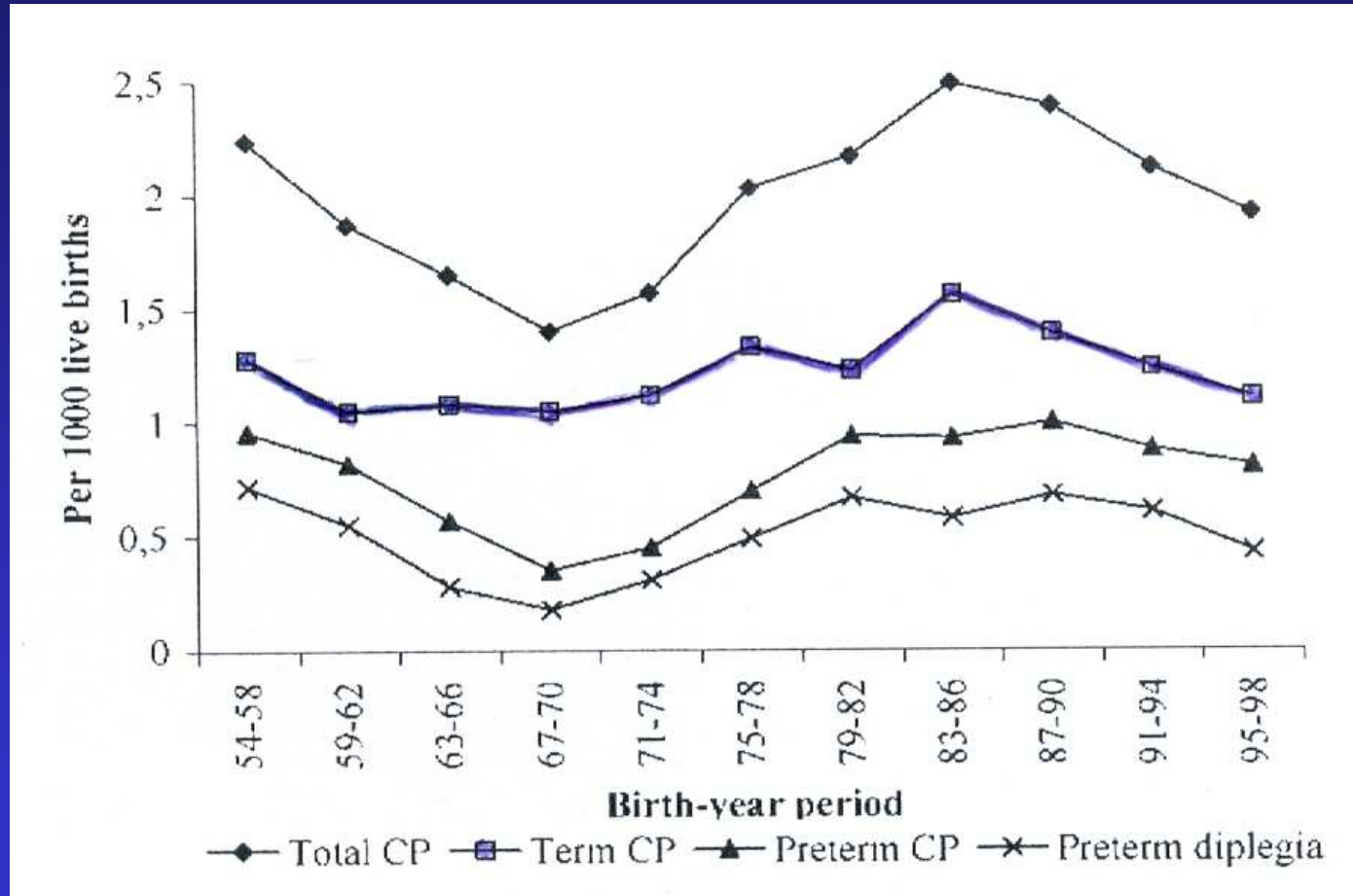
So, determine umbilical artery pH in cases with a low Apgar score

(Dyxhoorn et al, 1986; Ruth & Raivia, 1988; Dennis et al, 1989)

In conclusion

- Most children with fetal acidaemia at birth (pH<7.00) do well
- Outcome may well depend on direct neonatal care
- A low Apgar score is not the same as a low pH. So, determine umbilical cord pH in case of the birth of an infant with a low Apgar

Cerebral Palsy in South-Western Sweden



(Himmelman et al, Acta Paediatr, 2005)

Problems with intrapartum monitoring

- Correct interpretation of FHR patterns and interobserver variation
- Correct action in case of FHR abnormalities
- Low uptake of FBS, at least internationally

FHR monitoring during labour

- high sensitivity
 - poor specificity
-

FHR monitoring during labour

- **high sensitivity:**
normal = normal
 - **poor specificity:**
abnormal = only sometimes abnormal
-

RCT Electronic fetal monitoring - Auscultation

	N trials	Apgar	PND	Convulsions	CS (Odds)
EFM only	3	-	-	-	2.7 ↑ ↑
EFM + FBS	6	-	-	↓	1.3 ↑

(from: Effective care in pregnancy and childbirth, 1989)

FHR monitoring during labour

- **high sensitivity:**
normal = normal

- **poor specificity:**

Obstetric cowboys

Obstetric accidents in the UK:41 cases

- Inadequate FHR monitoring
- Lack of involvement of medical staff
- Inadequate records

- 7 FHR traces missing
- 20 of 34 FHR traces misinterpreted or not acted on!

Vincent et al, BJOG, 1991

Asphyxia related malpractice in Sweden (n= 177)

- **Neglecting to supervise fetal wellbeing (n= 173)**

- No FHR recording after admission test 12
- Uninterpretable FHR recording (poor quality) 41
- No FBS despite clear indication 100
- No follow up of previous FBS despite nonassuring FHR 20

- **Neglecting signs of fetal asphyxia (n=126, 71%)**

- More than 45 min from onset of abnormal FHR to birth 126
- Increasing i.v. oxytocin despite abnormal FHR 126
- Hyperstimulation of uterine contractions 61

Abnormal FHR pattern

- Do something:
- Fetal scalp sampling
- Stop oxytocin
- Administer a tocolytic drug
- Amnio-infusion
- Deliver the baby
- Ask your boss for help

But do not do nothing

STAN[®] S21 and S31



- ▶ CTG- and ECG-recording through scalp electrode
- ▶ Visual CTG-interpretation and classification
- ▶ Automatic calculation of T/QRS-ratio and classification of ST-changes
- ▶ Automatic detection of significant ST-changes/events/alerts

Meta-analysis RCTs ST analysis

	RR (95% CI)
Vag operative deliveries	0.88 (0.80-0.97)
Cord pH < 7.05 and BD > 12	0.73 (0.49-1.09)
Fetal blood sampling	0.65 (0.59-0.72)
Neon encephalopathy*	0.37 (0.14-1.00)

Westgate et al, 1993, Amer-Wahlin et al 2001, Ojala et al, 2006, Vassiere et al, 2007
n=9671. *19 infants with neon encephalopathy

Meta-analysis RCTs ST analysis

RR

Vag operative deliveries

Cord pH < 7.05 and BD > 12 0.38, 0.47, 2.43, 1.6

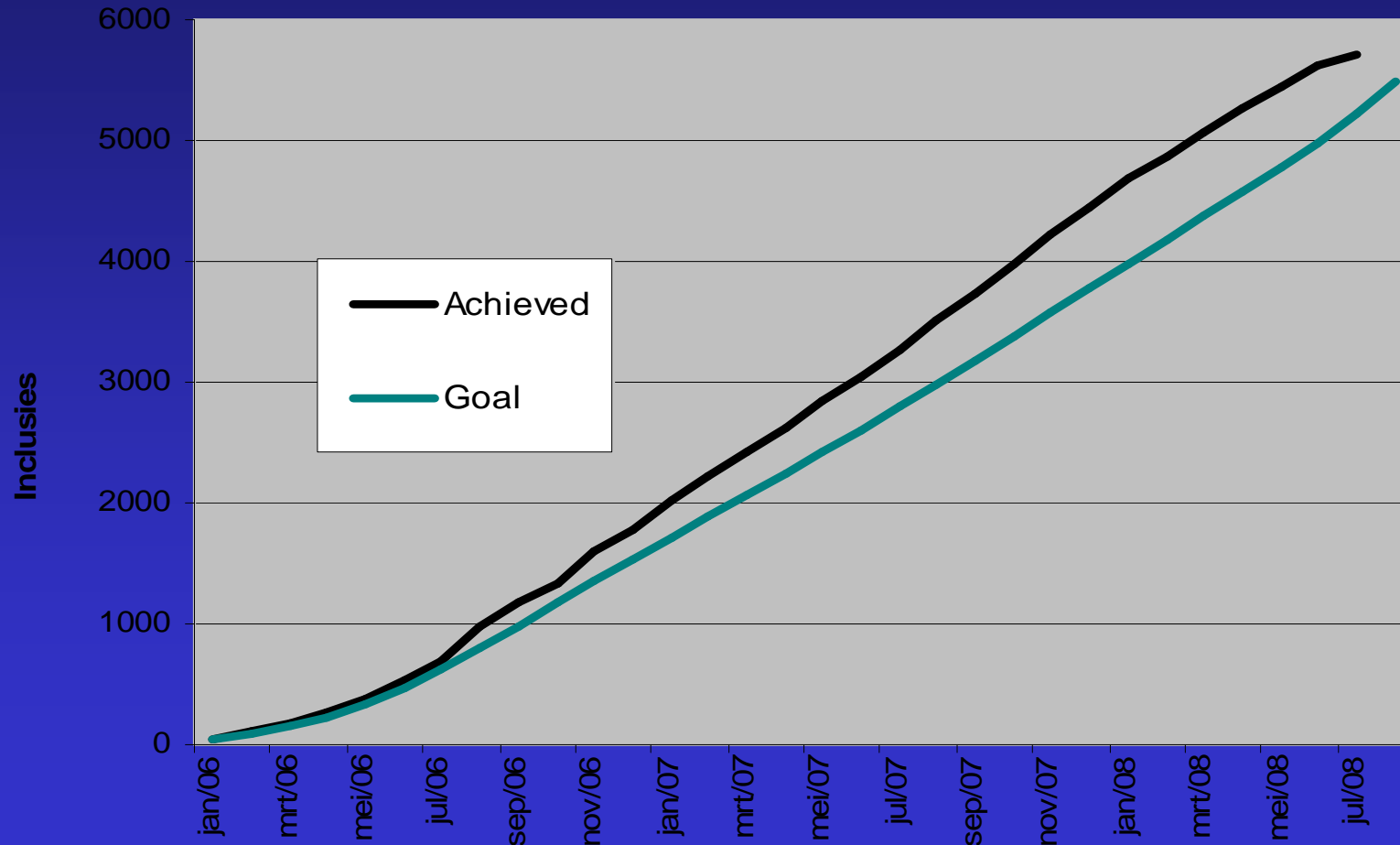
Fetal blood sampling

Neon encephalopathy*

Westgate et al, 1993, Amer-Wahlin et al 2001, Ojala et al, 2006, Vassiere et al, 2007
n=9671. *19 infants with neon encephalopathy

STAN Dutch RCT: 5681 inclusions

INCLUSION CURVE STAN TRIAL
laatste inclusie op 15-07-2008



Westerhuis et al, O&G 2010 (in press)

Results:metabolic acidosis

Data are presented as n (%). For details see text.

Outcome	Index group N=2827	Control group N=2840	Relative Risk (95% CI)
Primary outcome			
Cord-artery pH<7.05 & BDecf>12mmol/L	20 (0.7)	30 (1.1)	0.70 (0.38-1.28)
Secondary outcomes			
Cord-artery pH<7.05 & BDblood>12mmol/L	45 (1.6)	74 (2.6)	<u>0.63 (0.42-0.94)</u>
Cord-artery pH<7.05	55 (1.9)	78 (2.7)	<u>0.67 (0.46-0.97)</u>
Cord-artery pH<7.00	18 (0.6)	34 (1.2)	0.56 (0.31-1.01)
Apgar score 1 min < 4	49 (1.7)	40 (1.4)	1.25 (0.82-1.90)
Apgar score 5 min < 7	42 (1.5)	34 (1.2)	1.24 (0.79-1.95)
Total neonatal admissions	391 (13.8)	441 (15.5)	0.90 (0.80-1.02)
Admission to a NICU	40 (1.4)	45 (1.6)	0.89 (0.58-1.35)
Hypoxic ischemic encephalopathy			
Moderate (Sarnat grade 2)	2 (0.1)	1 (<0.1)	- **
Severe (Sarnat grade 3)	1 (<0.1)	0 (0.0)	- **
Perinatal death	3 (0.1)	2 (0.1)	- **

* Absolute numbers (%) in this table were based on the mean of ten imputations.

** Relative risk (95% CI) was not calculated due to very low numbers.

Westerhuis et al, O&G,
2010, in press

STAN Dutch RCT

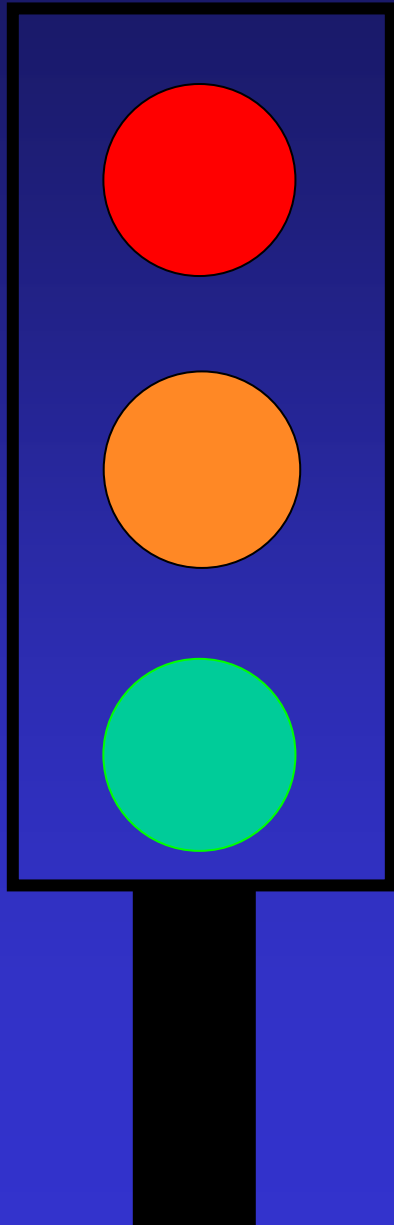
- STAN also works in the Netherlands
- 30-40 % lower incidence of acidaemia
- 50% reduction FBS
- No difference in instrumental deliveries
- No difference in direct neonatal outcome

Biggest problem continues to be:

- Human factor

12 Swedish 'false-negative' cases

- 1 In three cases, the fetuses had a preterminal fetal heart rate (FHR) admission test (absent variability with late decelerations; 'flat tracing'), but the obstetrician did not act due to the absence of STAN events.
- 2 In three cases, the obstetrician did not act despite an ominous cardiotocogram (CTG), again due to the absence of STAN events.
- 3 In six cases, the obstetrician did not take proper action despite both an ominous CTG pattern and positive STAN events. However, in three of the cases, the STAN events appeared late in the hypoxic process.



= Emergency

= Do something, or call your boss

= Everything OK

In utero prevention cerebral impairment

- Anti-oxidants (Allopurinol) to prevent reperfusion damage, in case of in utero asphyxia
- Effectiveness shown in major cardiac surgery in infants
- Intrapartum administration results in lower S-100B levels in cord blood (Torrance et al, Pediatrics, 2009)



Thank you