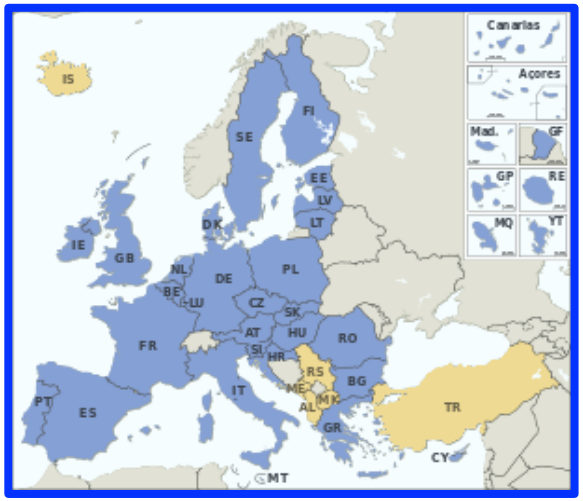
Quality Improvement in the NICU Using Network Structures

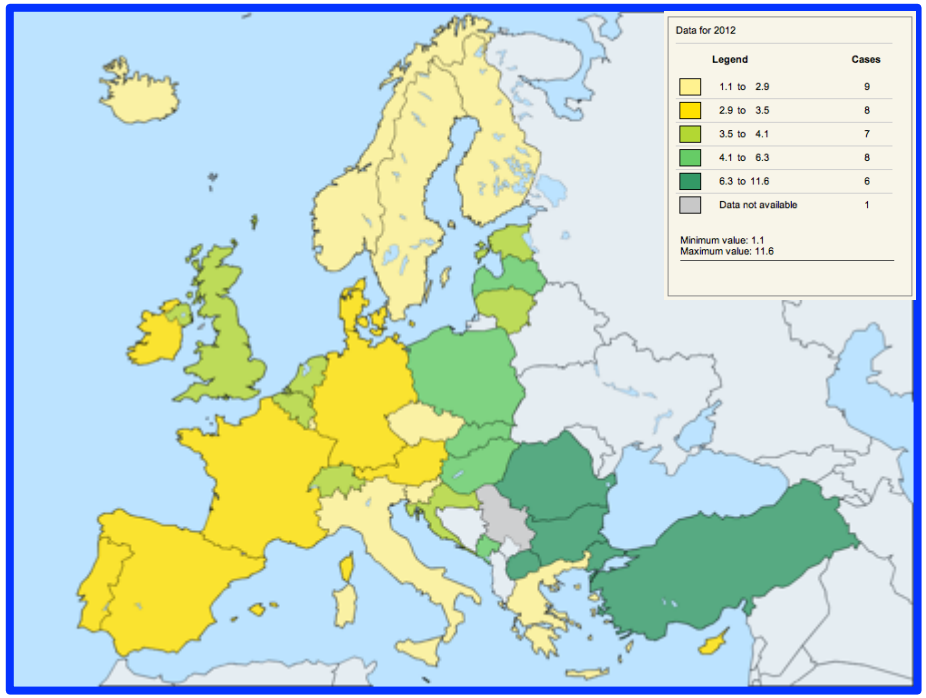
NEONATUS 2015

Poznan, Sept 24-25, 2015

Prof. Dr. H. Hummler

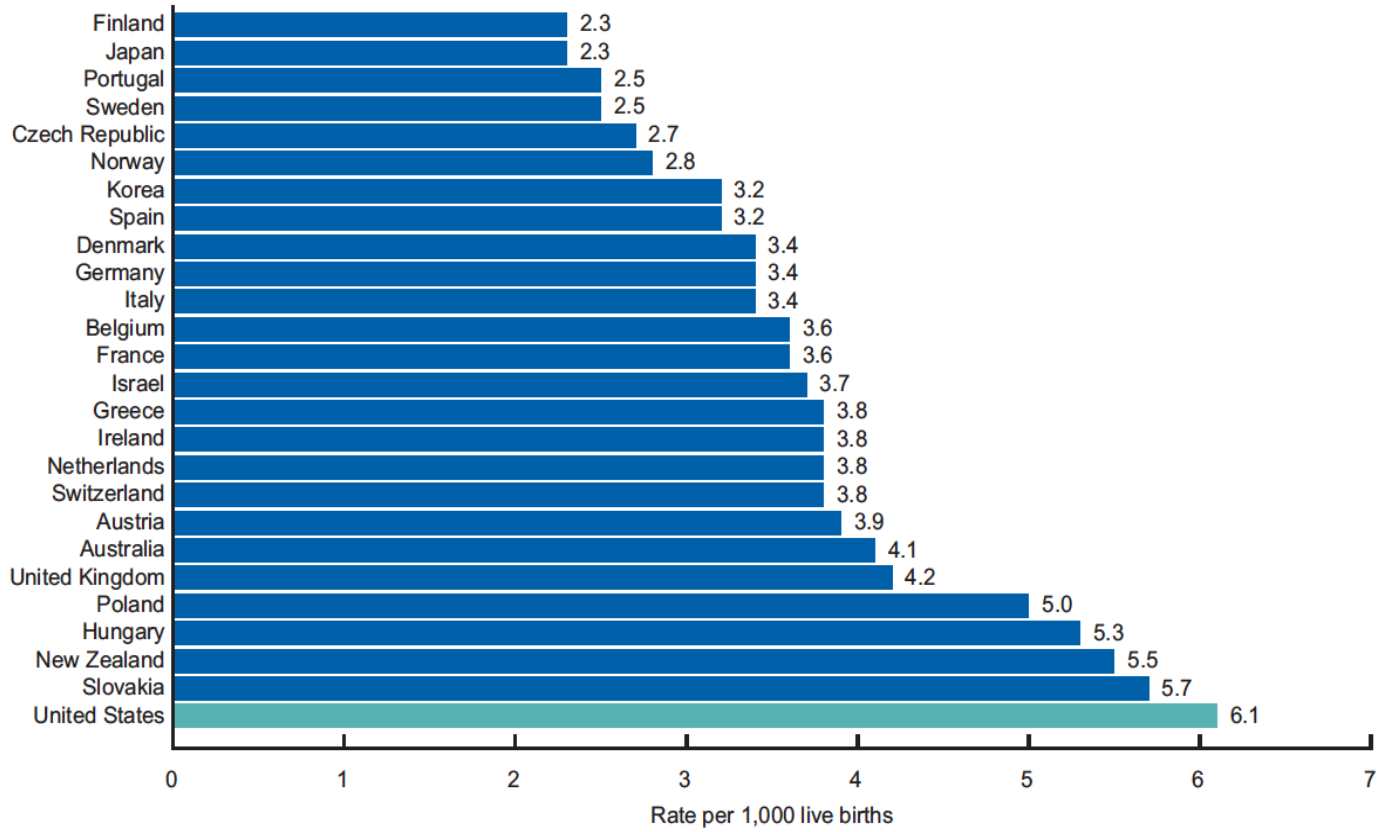
European Union is Very Diverse





- 28 member countries
- 506 Mio. inhabitants
- 4.3 Mio. km^2
- Health politics largely driven by individual countries
- Large differences in infant mortality

Infant Mortality Rate
European Countries vs. U.S.A./Other Countries



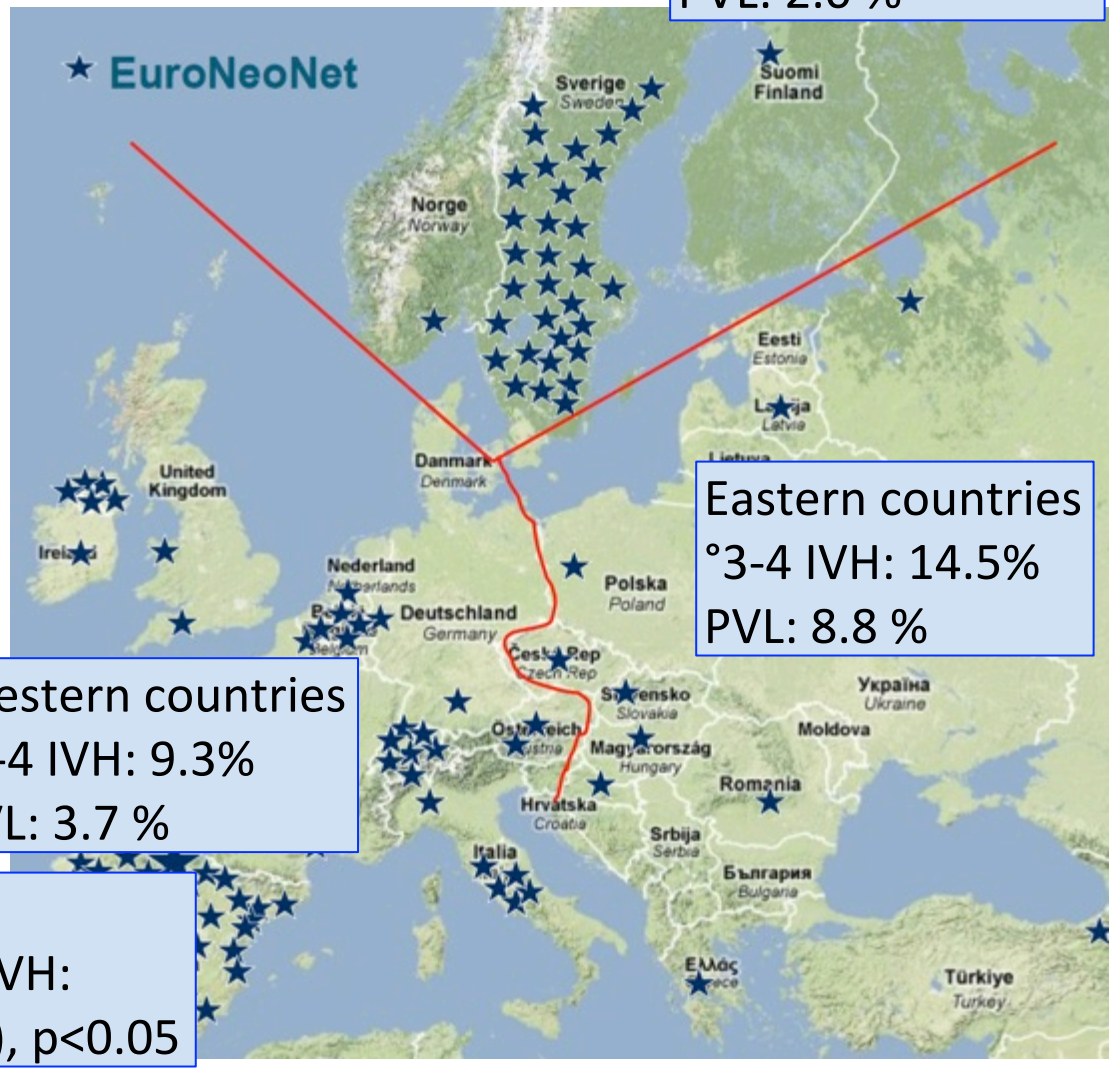
NOTES: Canada's 2010 data were not available from the Organisation for Economic Co-operation and Development (OECD) at the time of manuscript preparation. The 2009 infant mortality rate for Canada was 4.9. If the 2010 data for Canada had been available, the U.S. ranking may have changed. Deaths at all gestational ages are included, but countries may vary in completeness of reporting events at younger gestational ages.
SOURCES: CDC/NCHS, linked birth/infant death data set (U.S. data); and OECD 2014 (all other data). Data are available from: http://www.oecd.org.

Figure 1. Infant mortality rates: Selected Organisation for Economic Co-operation and Development countries, 2010

Rate of IVH and PVL
EuroNeoNet Data

- 36.607 VLBWI
- 194 NICUs in 19 countries
- 2006-2012
- Rate of IVH °3/4 and cystic PVL

Northern countries
°3-4 IVH: 5.0%
PVL: 2.0 %



Eastern countries
°3-4 IVH: 14.5%
PVL: 8.8 %

Western countries
°3-4 IVH: 9.3%
PVL: 3.7 %

Change over time only in Western countries for °3-4 IVH: 10.8% (2006) to 8.7% (2012), $p<0.05$

Objectives

- … to discuss the possible benefits and difficulties in setting up a neonatal network in a heterogenous population in Europe

- … to describe how benchmarking in a neonatal network may help to improve practice in neonatal care in European NICUs
  - from a more global and from an individual unit perspective

EuroNeoNet

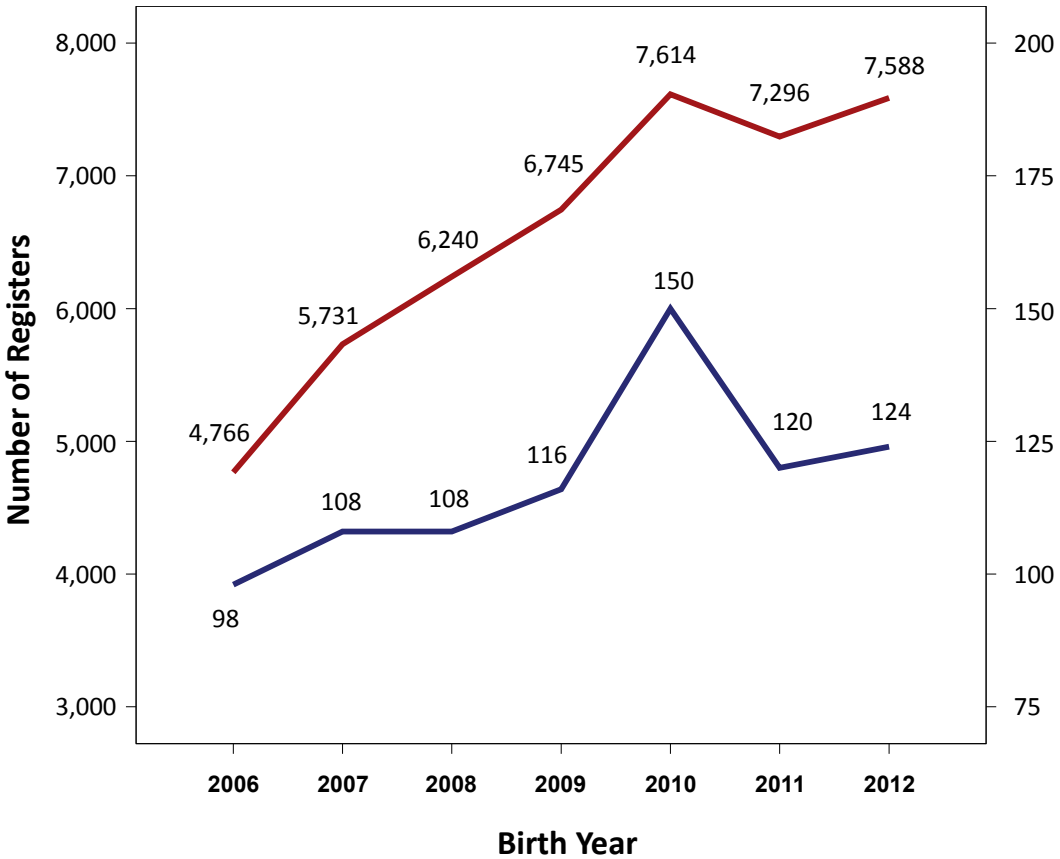
- Founded in 2003
- Data collection in VLBWI was started in 2006

EuroNeoNet

Our Vision

- … is that all VLGA and/or VLBW newborn infants born in Europe, receive the best available health care no matter where they are born, by identifying any existing inequalities and promoting that all Neonatal Units share a standardised set of perinatal risk and protective indicators, utilize evidence-based neonatal interventions and record data on short- and long-term outcomes for those tiny and vulnerable infants.

Participating Centers



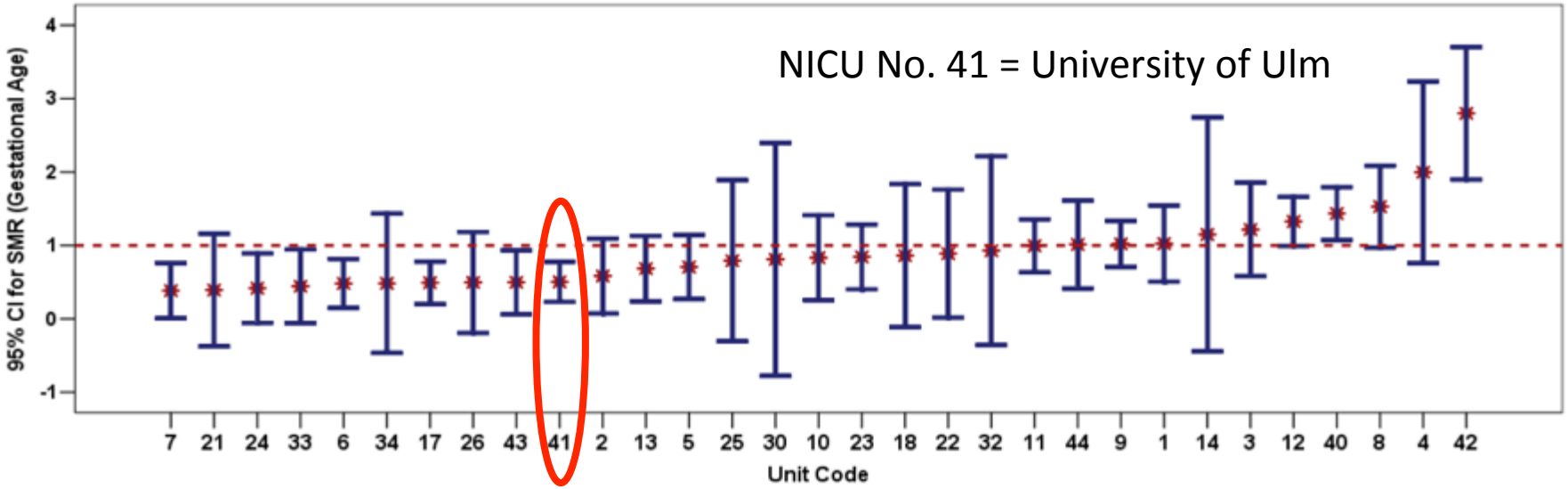
	Nº Units	Nº Cases
2006	98	4,766
2007	108	5,731
2008	108	6,240
2009	116	6,745
2010	150	7,614
2011	120	7,296
2012	124	7,588
2013	11	680
TOTAL	**204**	**46,660**

Benchmarking from a NICU Perspective

Mortality EuroNeoNet 2008

- 44 NICUs, 2828 patients (GA <30 wks or BW <1500g)
- Large variability in the rate of multiples, cesarean section, prenatal steroids, mortality and morbidity
- adjusted for gestational age

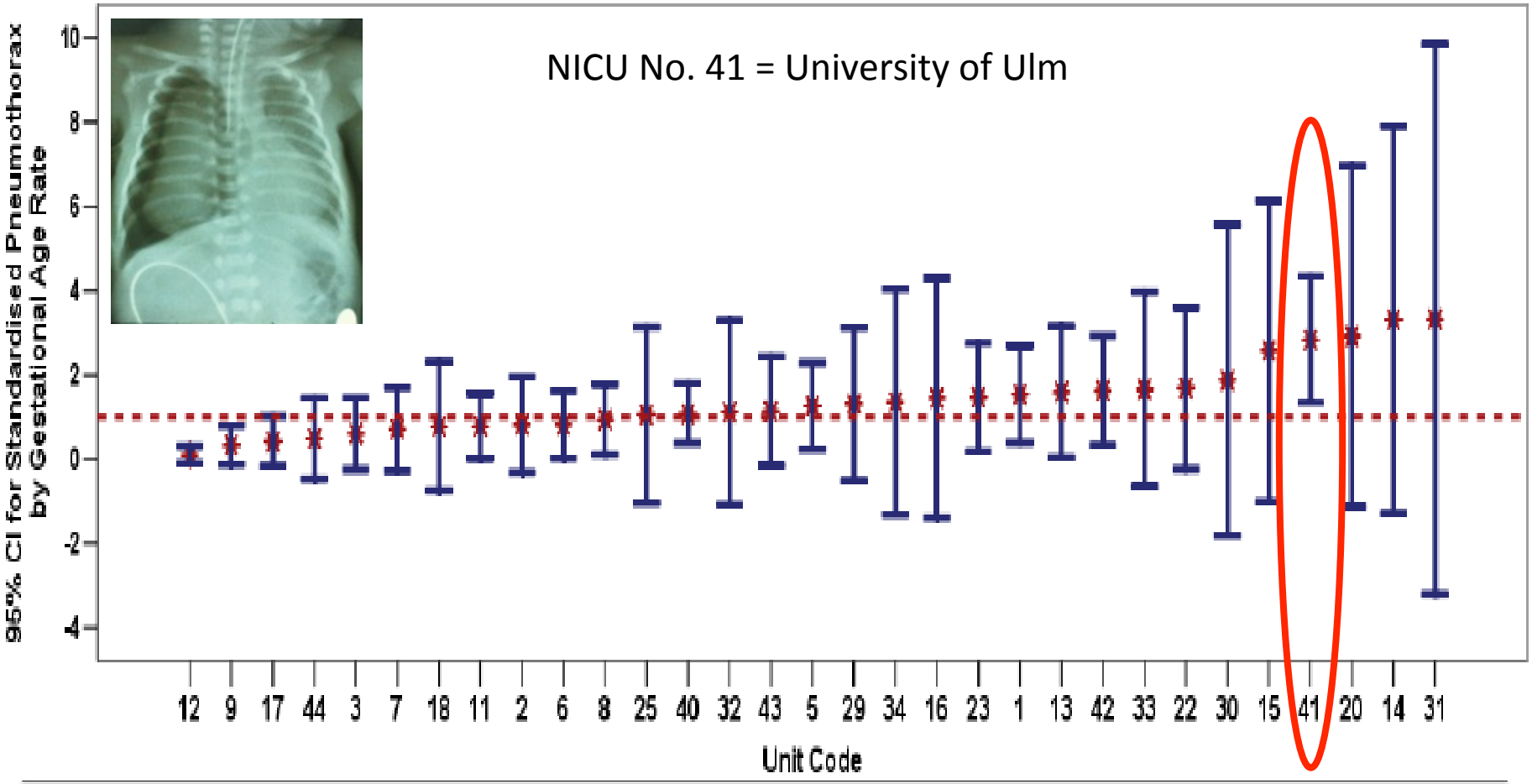
Graph 5.20.2.1



- „Excess Mortality“: - 12.8 deaths (i.e. 12 lives saved)

Benchmarking from a NICU Perspective

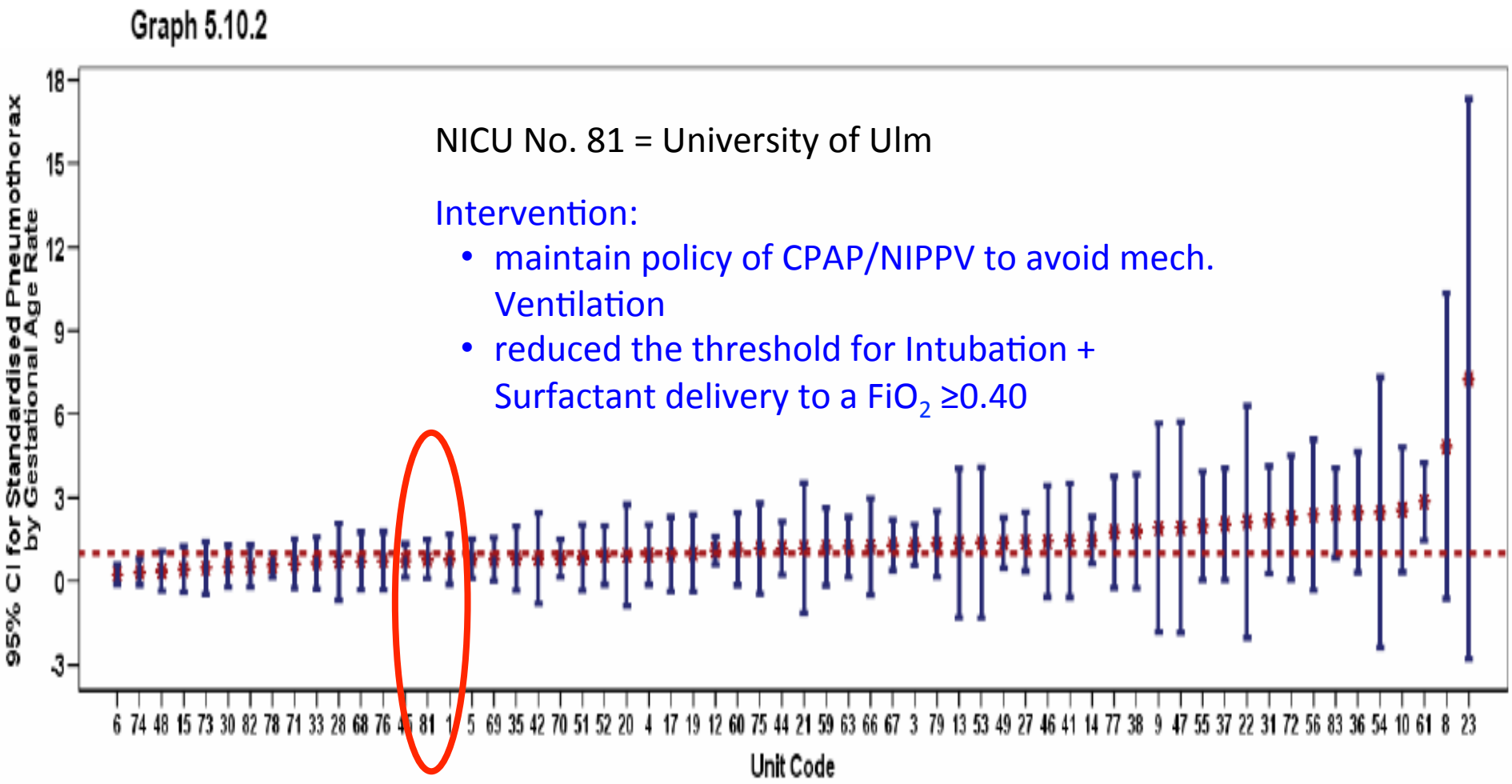
Rate of Pneumothorax: University of Ulm 2008



EuroNeoNet: Yearly Report 2008

Benchmarking from a NICU Perspective

Rate of Pneumothorax: University of Ulm 2009



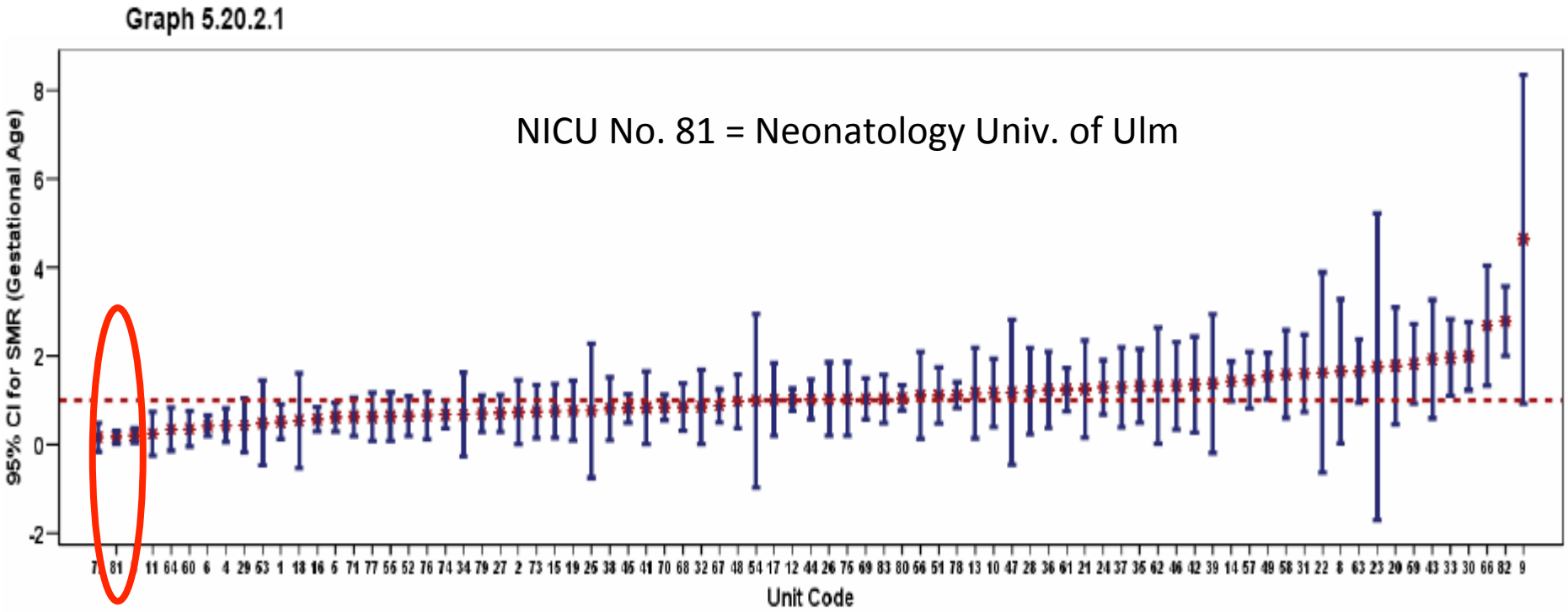
NICU No. 81 = University of Ulm

Intervention:

- maintain policy of CPAP/NIPPV to avoid mech. Ventilation
- reduced the threshold for Intubation + Surfactant delivery to a FiO_2 ≥0.40

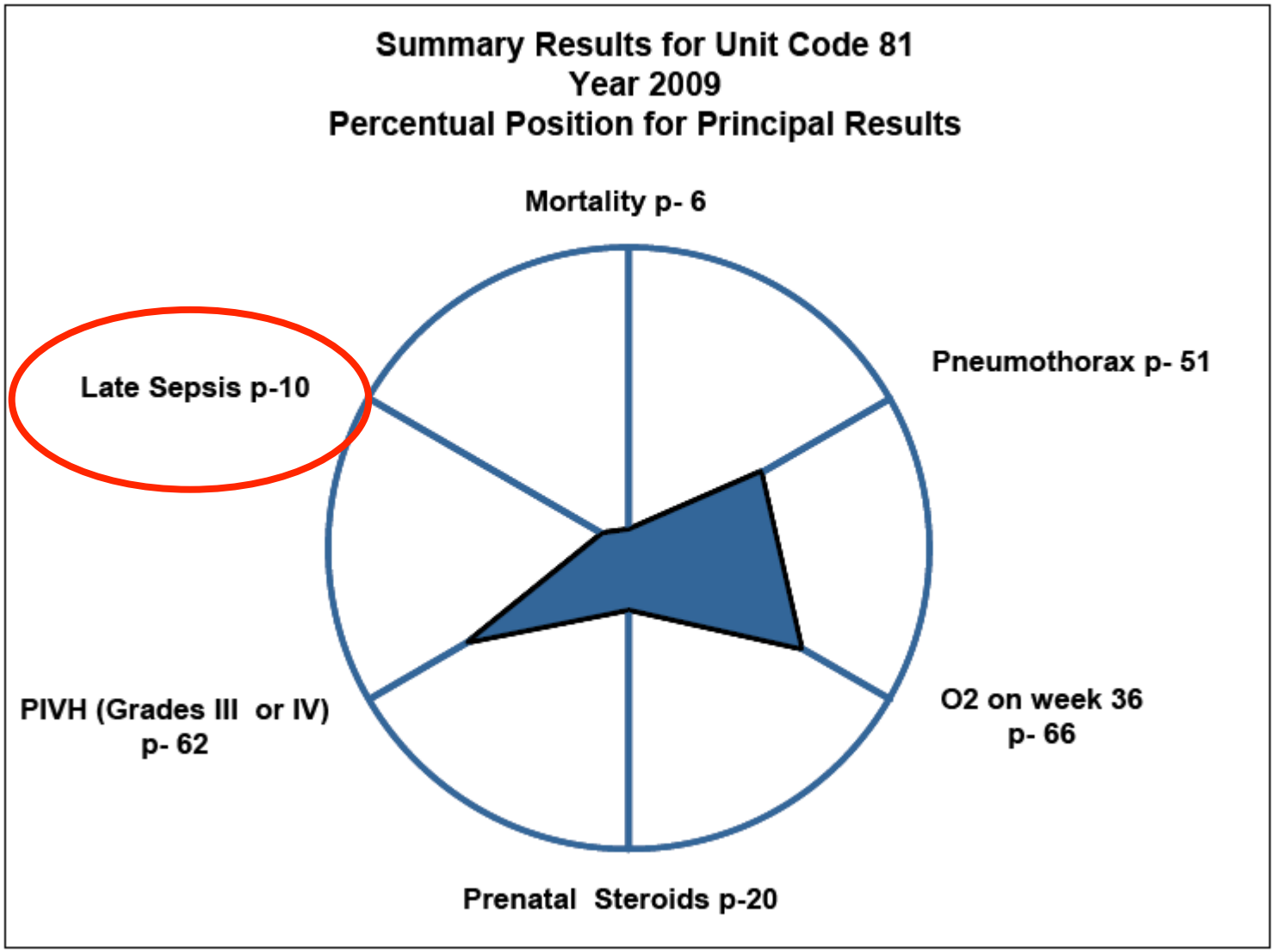
EuroNeoNet: Mortality 2009

- 83 NICUs, 6479 Patients (GA <30 wks or BW <1500g)
- Large variability in the rate of multiples, cesarean section, prenatal steroids, mortality and morbidity
- adjusted for gestational age



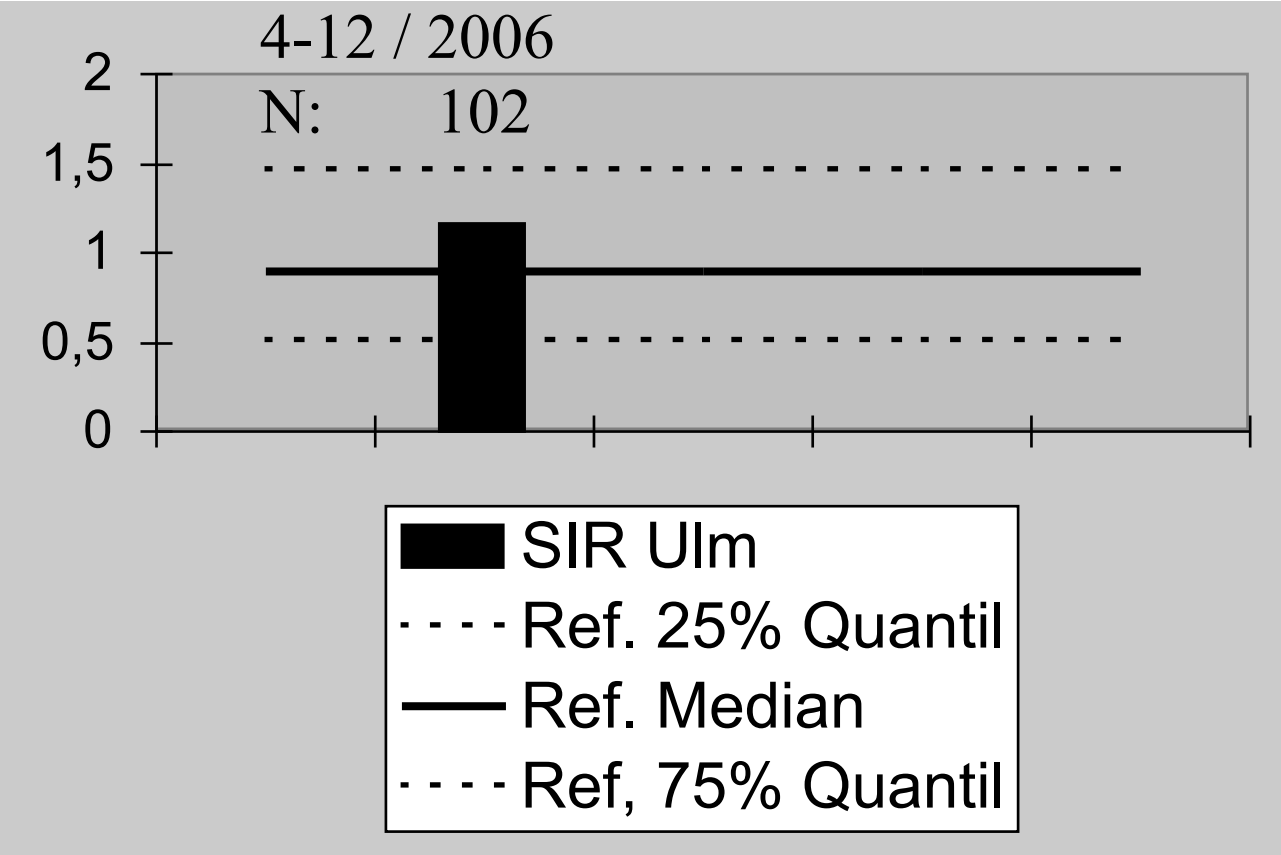
- „Excess Mortality“: - 23.8 deaths (i.e. 23 lives saved)

Results EuroNeoNet:
Funnelplot University of Ulm 2009



National Neonatal Infection-Control Germany (Neo-KISS)
Mandatory for all Level 2/3 NICUs Germany since 2006

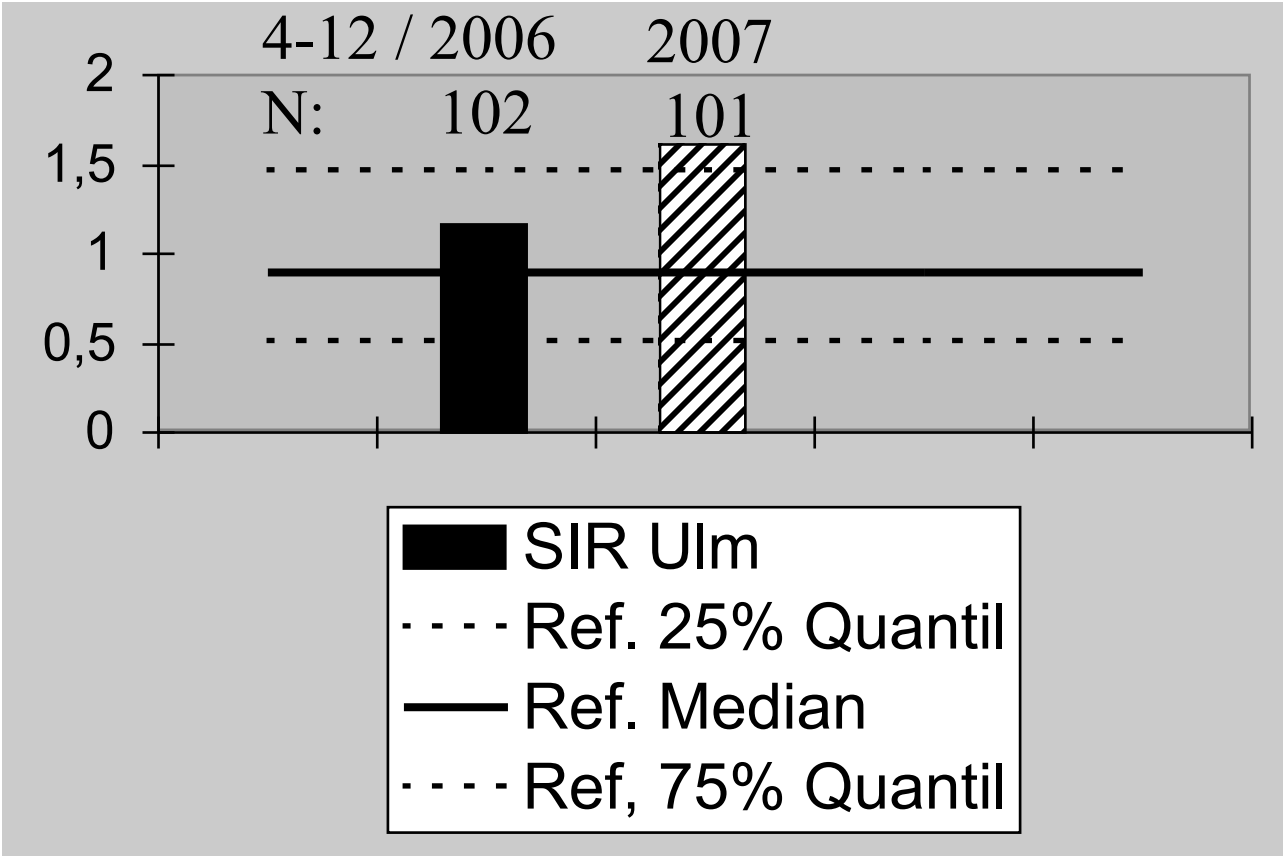
Standardized Rate of Infection BW <1500g
Ulm vs. National Reference Data



[Reference values 2003-2007]

Neo-KISS: Standardized Rate of Infection BW <1500g

Ulm vs. National Reference Data



[Reference values 2003-2007]

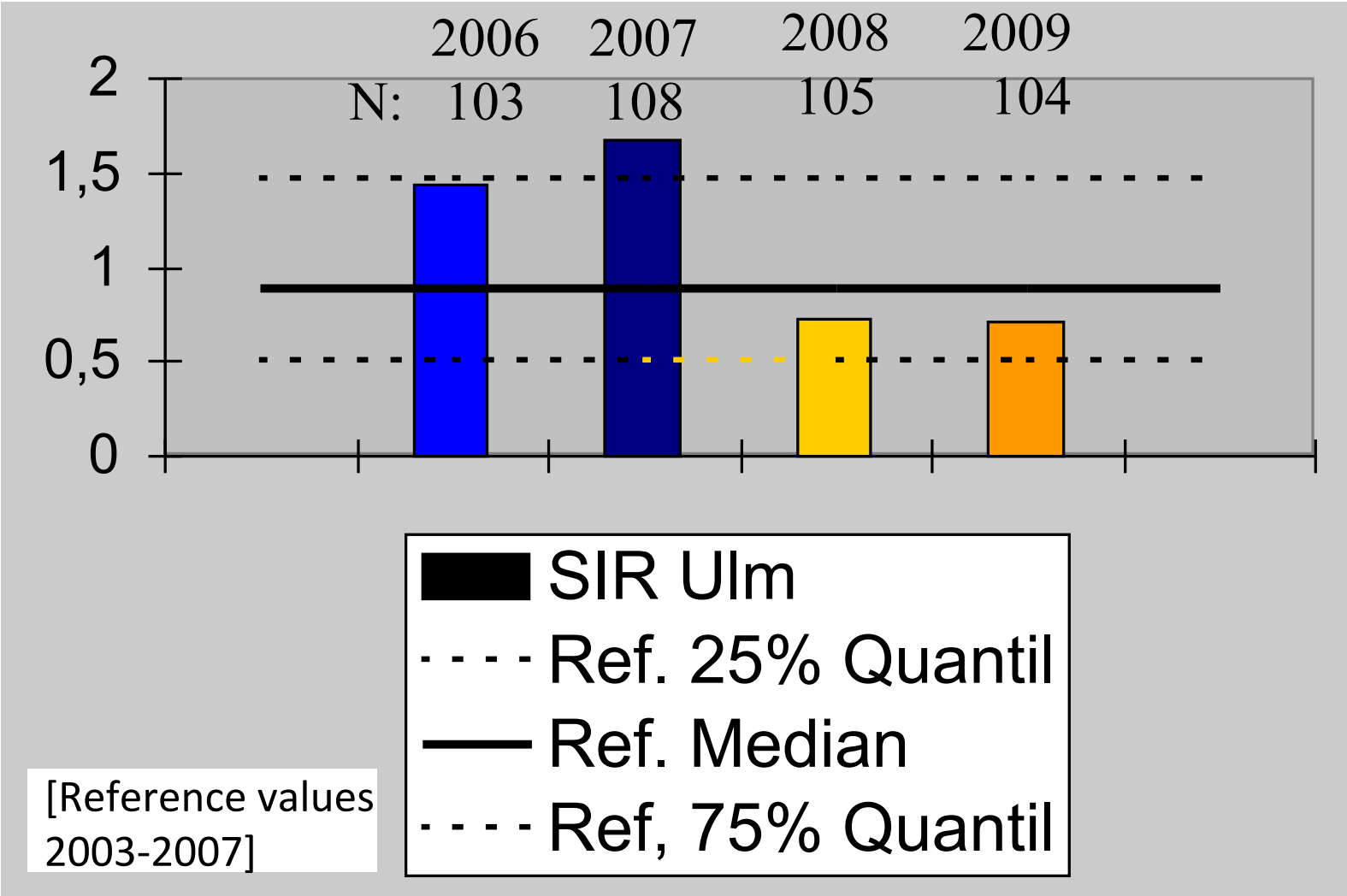
Measures undertaken (bundles)

- Hygienic counseling, site visits by hygiene experts
- Staff eduction: Systematic training sessions in hygiene
- New local guidelines based on new national recommendations (Robert-Koch Institute)
- Training + Handout on hygiene for parents – systematic training of all new parents from first day of life/infant
- Teaching of cleaning personnel
- Regular workshops on hand hygiene
- Additional nurses
- Educational studies: skin cultures at catheter insertion site after desinfection/insertion
- …

Standardized Rate of Infection for BW<1500g

Ulm vs. National Reference Data (Neokiss)

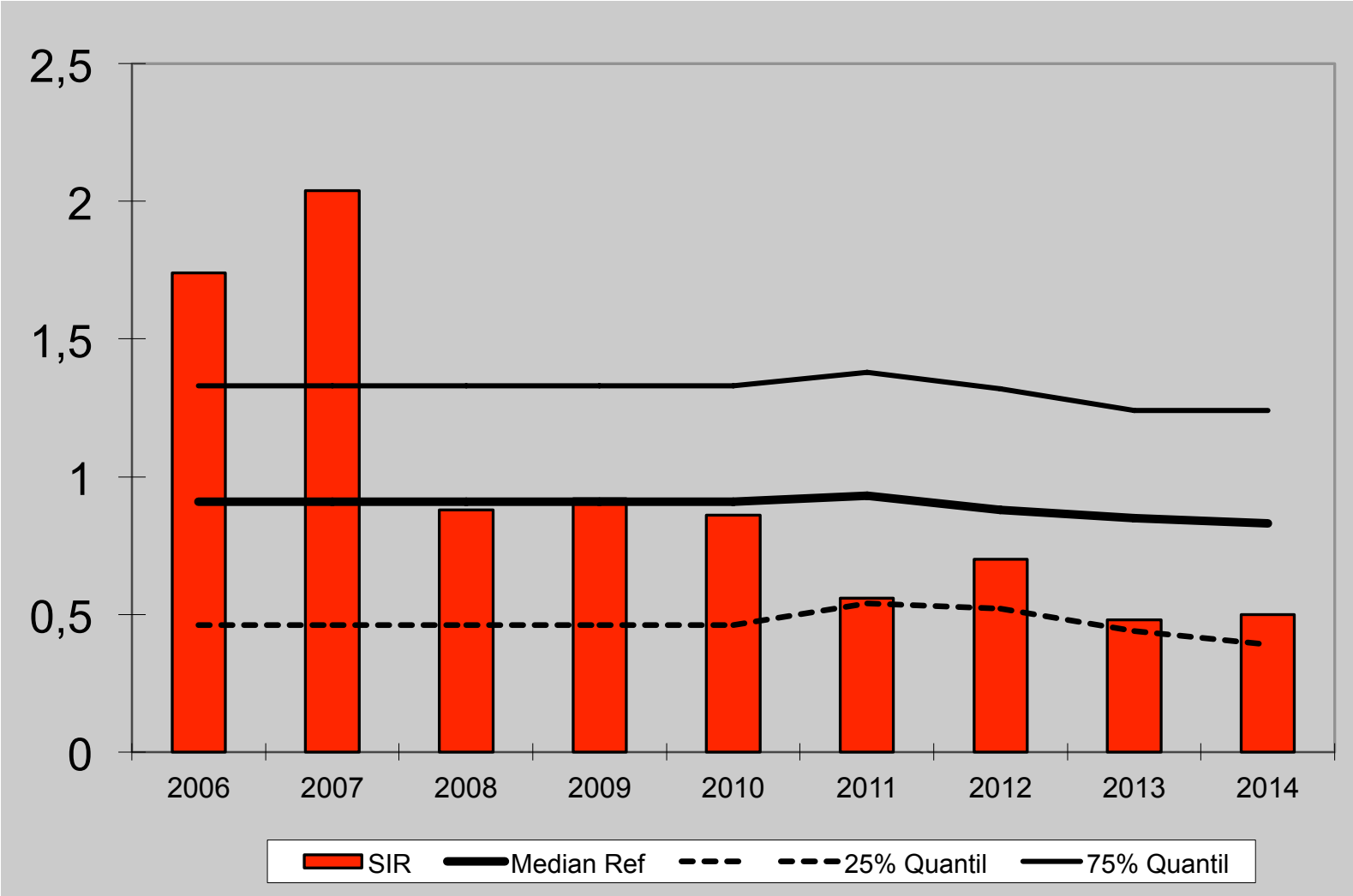
Ratio observed rate/expected rate



[Reference values 2003-2007]

Neo-KISS University of Ulm since 4/2006

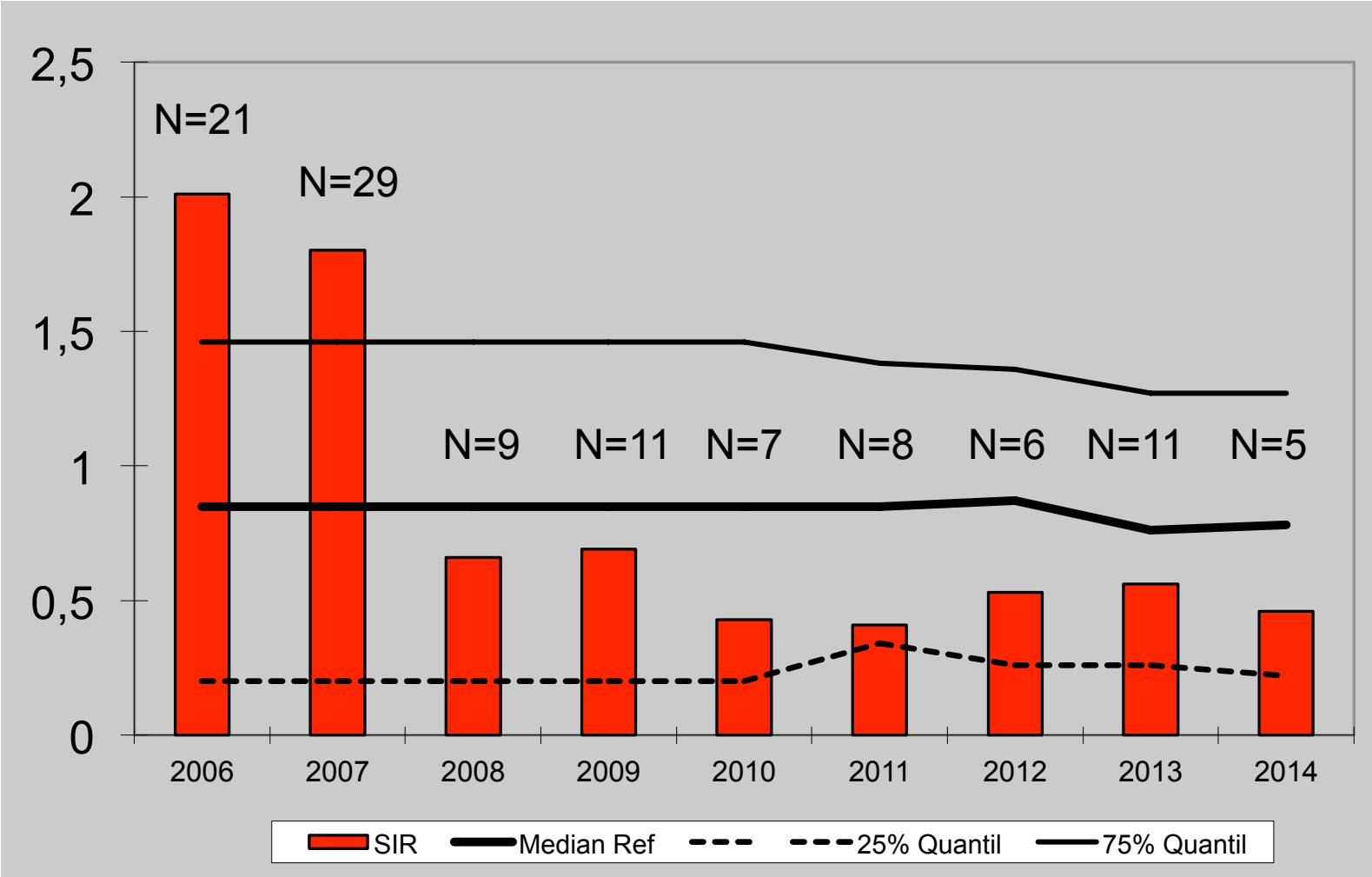
Standardized Infection Rate: Sepsis

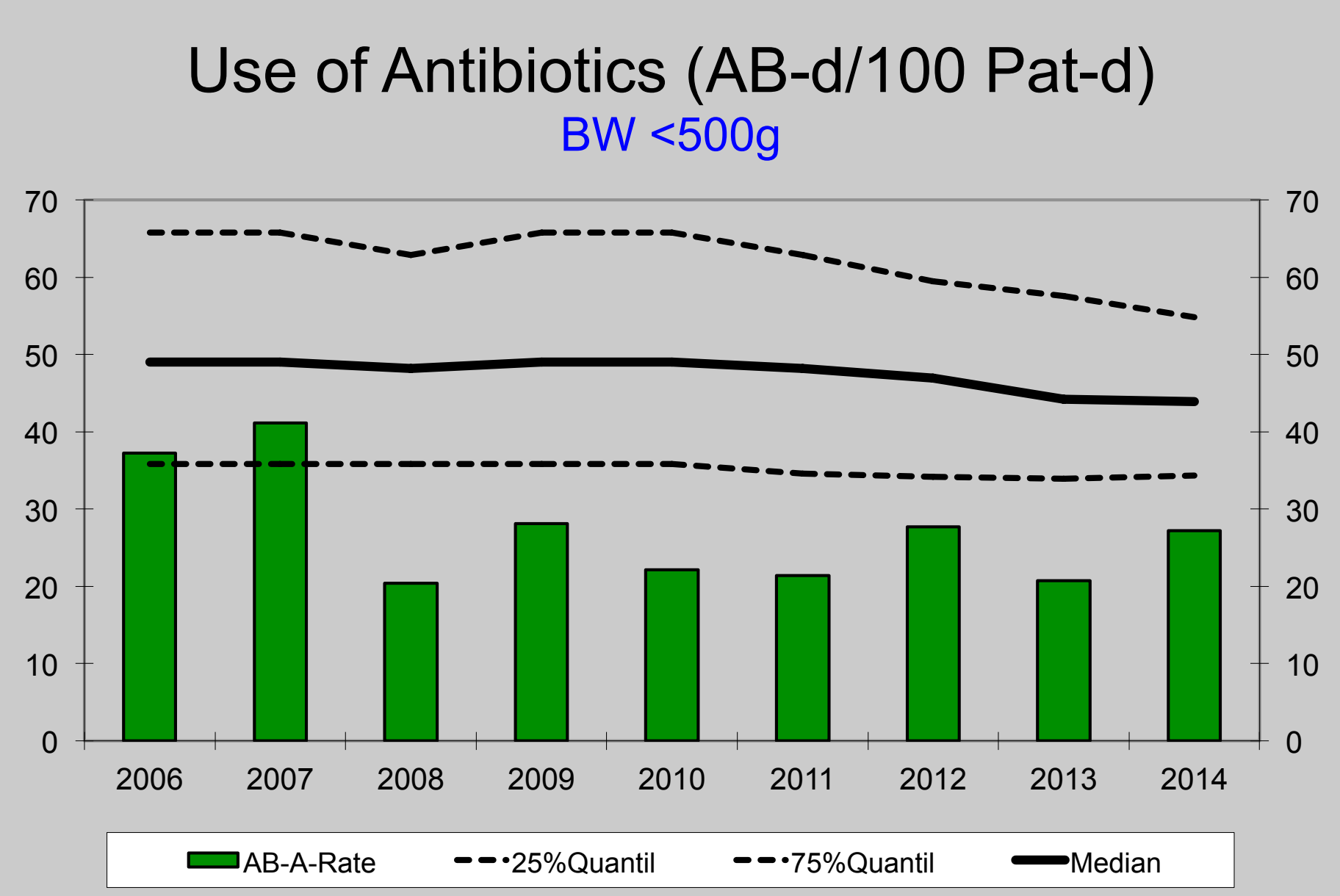


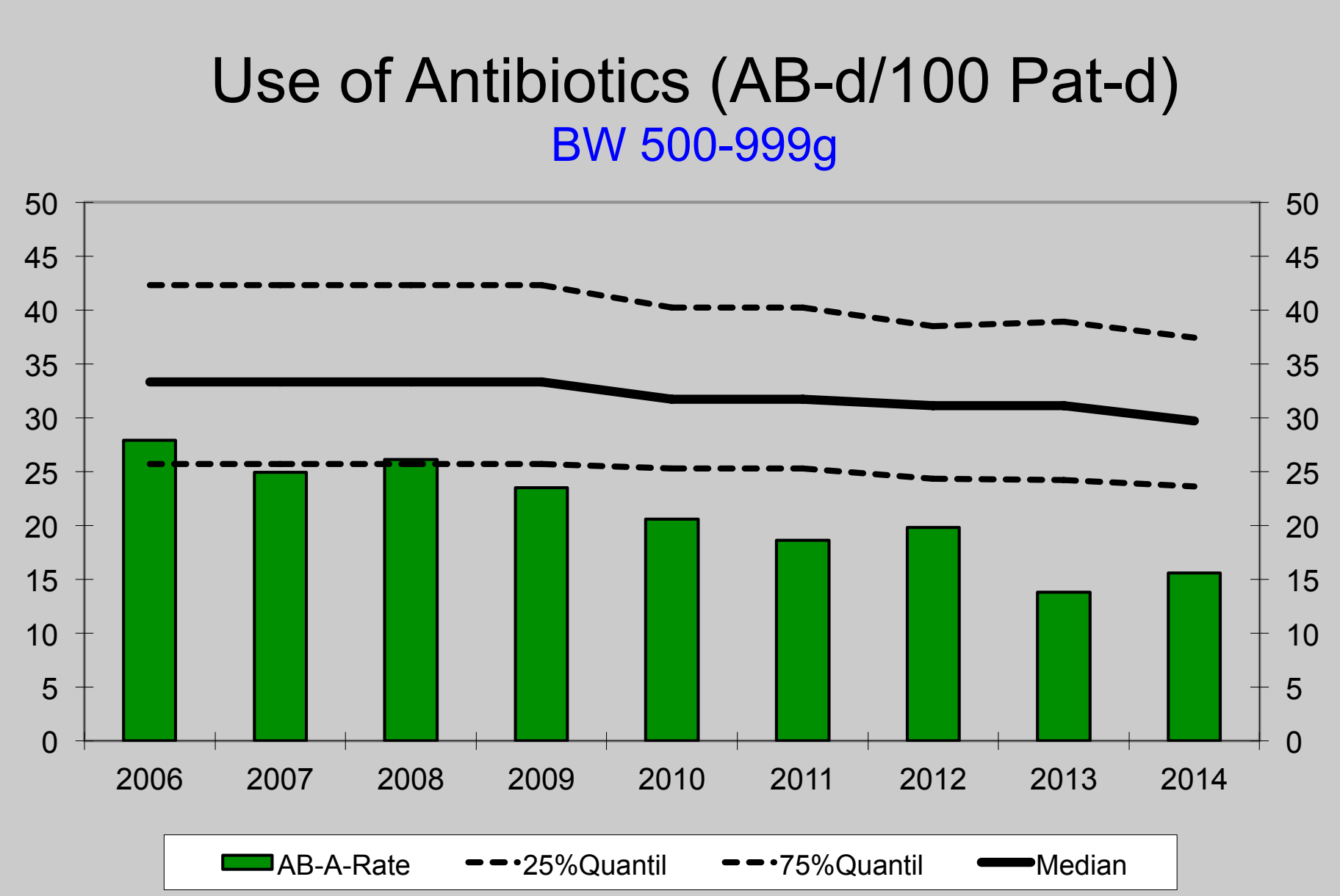
Neo-KISS University of Ulm since 4/2006

Standardized Infection Rate

Sepsis related to Central Venous Line




Use of Antibiotics (AB-d/100 Pat-d)
BW <500g
70
60
50
40
30
20
10
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
AB-A-Rate
25%Quantil
75%Quantil
Median


Use of Antibiotics (AB-d/100 Pat-d)
BW 500-999g
50
45
40
35
30
25
20
15
10
5
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
AB-A-Rate
25%Quantil
75%Quantil
Median

Reducing Neonatal Nosocomial Bloodstream Infections - Participation in a National Surveillance System

- NeoKiss, Germany introduced in 2000 as a voluntary network
  - VLBWI, 24 NICUs, 3856 patients, 152.437 patient days
- Incidence density
  - 1st year: 8.3 BSIs/1000 patient days
  - 3rd year: 6.4 BSIs/1000 patient days
- logistic regression analysis
  - OR 0.73 (0.60-0.89) third vs. first year

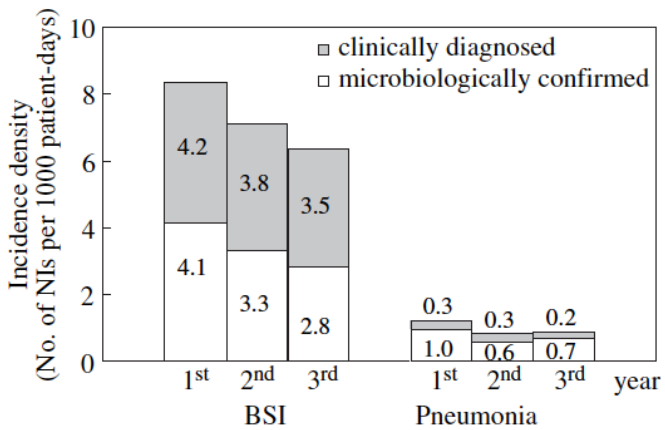


Figure 2 Incidence densities of microbiologically confirmed and clinically diagnosed bloodstream infection (BSI) and pneumonia by year of participation. NI, nosocomial infections.

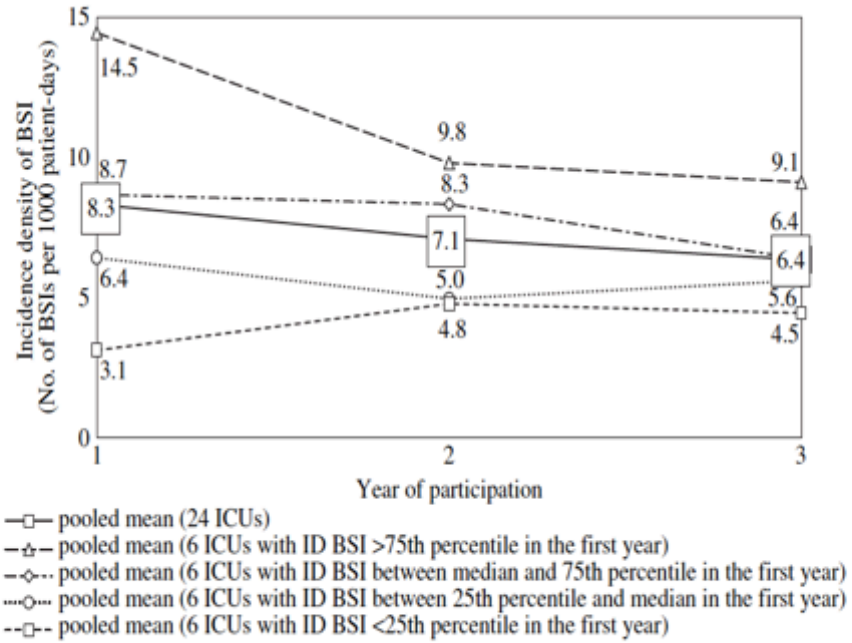


Figure 1 Trend of the pooled mean of incidence density (ID) of bloodstream infection (BSI) for groups of intensive care units (ICUs) with different start levels of incidence density in the first year of participation.

Schwab et al. J Hosp Infection 2007;65:319

The Step from a Voluntary to a Mandatory National Nosocomial Infection Surveillance System: Influence on Infection Rates and Surveillance Effect

Government mandated participation in Neokiss for all German Perinatal Centers

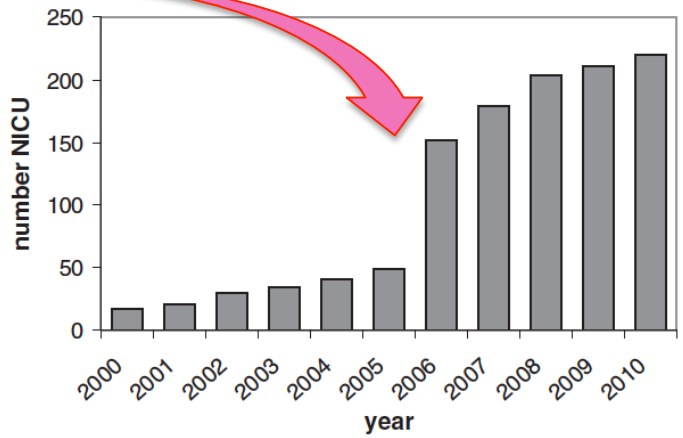


Figure 1 Development of the annual number of participating neonatal intensive care units (NICU) in NEO-KISS.

Table 3 Results of univariable and multivariable analysis comparing primary BSI rates the 3rd and 1st year of participation in NEO-KISS

HCAI infection rate	Old/voluntary participants (N = 26, starting in NEO-KISS January 2000- December 2002)		New/mandatory participants (N = 95, starting in NEO-KISS January-December 2006)	
	univariable analysis pooled data 3rd *vs.* 1st year	multivariable analysis adjusted effect measures	univariable analysis pooled data 3rd *vs.* 1st year	multivariable analysis adjusted effect measures
BSI Incidence density (per 1000 patient days)	RR = 0.79; (CI95 0.68-0.91); p = 0.001	IRR[a] = 0.78; (CI95 0.66-0.93); p = 0.005	RR =0.79; (CI95 0.69-0.90); p < 0.001	IRR[a] = 0.81; (CI95 0.68-0.97); p = 0.019

CI95, 95% confidence interval; RR, relative risk; IRR, adjusted incidence rate ratio; p, p-value;
[a] Poisson regression models with the outcome number BSI and log number patient days as offset parameter calculated by generalized estimating equation (GEE) model which account for clustering effect within a single NICU, consider the following parameters: birth weight (5 categories, 250gram steps), gestational age (4 categories, <27/27-28/29-30/>30 weeks), sex, mode of delivery (sectio) and surveillance endpoint (3 categories: 1800 g/transfer/died).

Schwab et al. Antimicrobiol Resistance and Infection Control 2012;1:24

„EuroNeoKiss“

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AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF THE PEDIATRICS

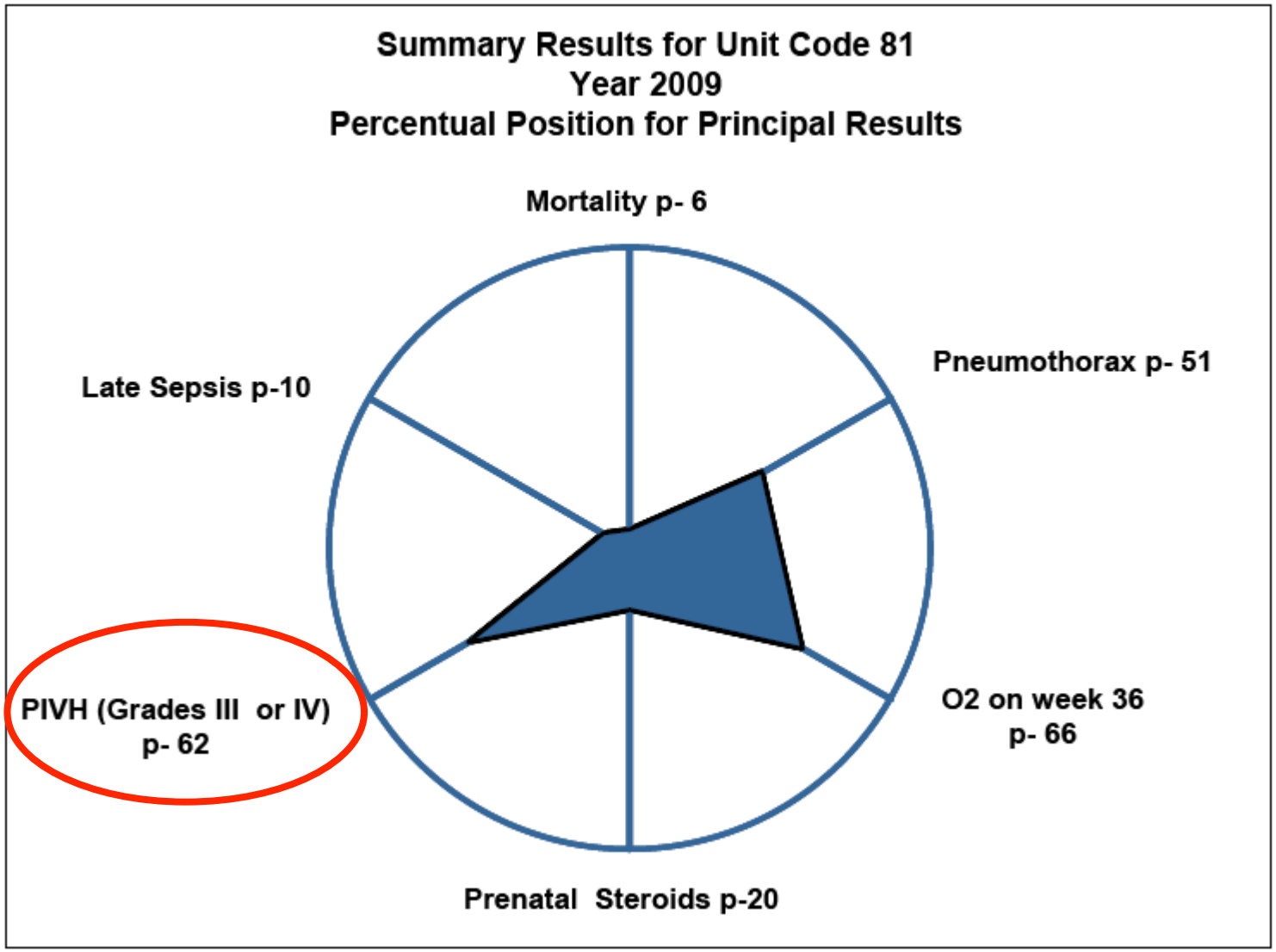
International Perspectives: Preventing Sepsis in VLBW Infants: Experience from Neonatal Networks and Voluntary Surveillance Systems

Adolf Valls-i-Soler, Marisela Madrid, Christine Geffers and Helmut D. Hummler

Neoreviews 2010;11;e403
DOI: 10.1542/neo.11-8-e403

- Data collected in EuroNeoNet NICUs since 2013 in
  - Germany
  - Belgium
  - Spain
  - …

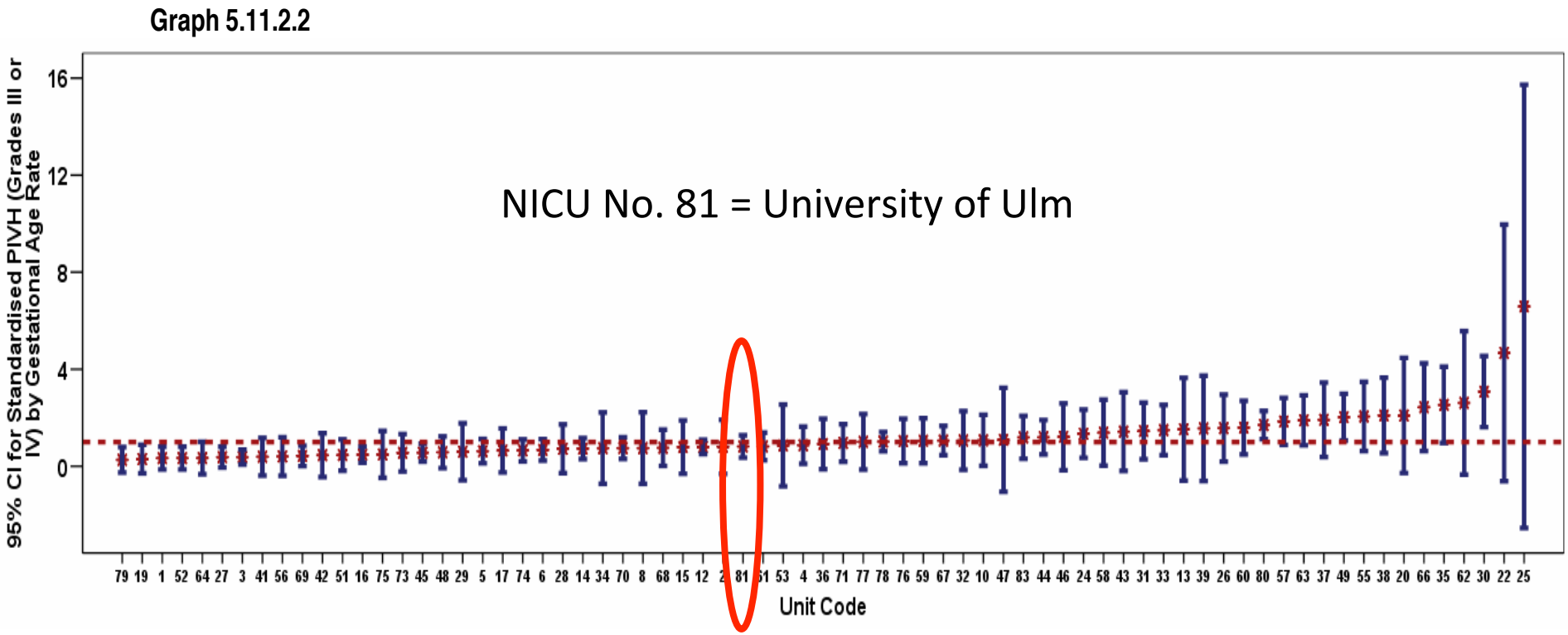
Results EuroNeoNet:
Funnelplot University of Ulm 2009



EuroNeoNet: Mortality 2009

Rate of IVH Grade 3-4

- Large variability in the rate of IVH adjusted for gestational age



Results @ 1 Year

Rate of IVH Before and After the Intervention

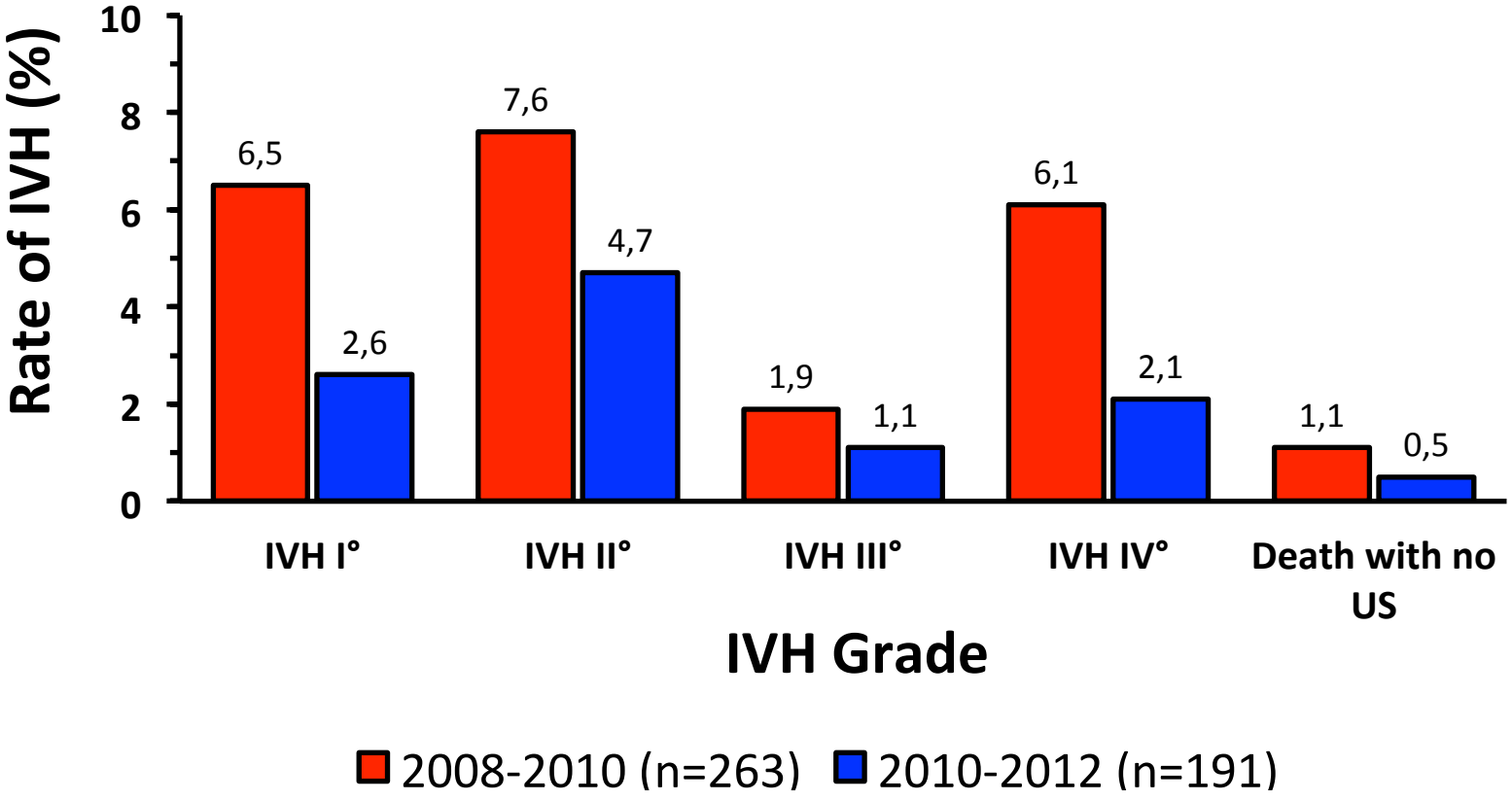
(multiprofessional and interdisciplinary IVH-working group, regular „IVH-Conference“ for surveillance of risk factors in cases)

	1/2008 - 7/2010		8/2010 - 8/2011	
No IVH	198	76,7 %	102	90,3 %
IVH I°	17	6,7 %	4	3,5 %
IVH II°	20	7,8 %	3	2,7 %
IVH III°	5	1,9 %	1	0,9 %
IVH IV°	15	5,8 %	3	2,7 %
unknown	3	1,2 %	0	0 %
IVH/unknown	60	23,3 %	11	9,7 %

Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Rate of IVH

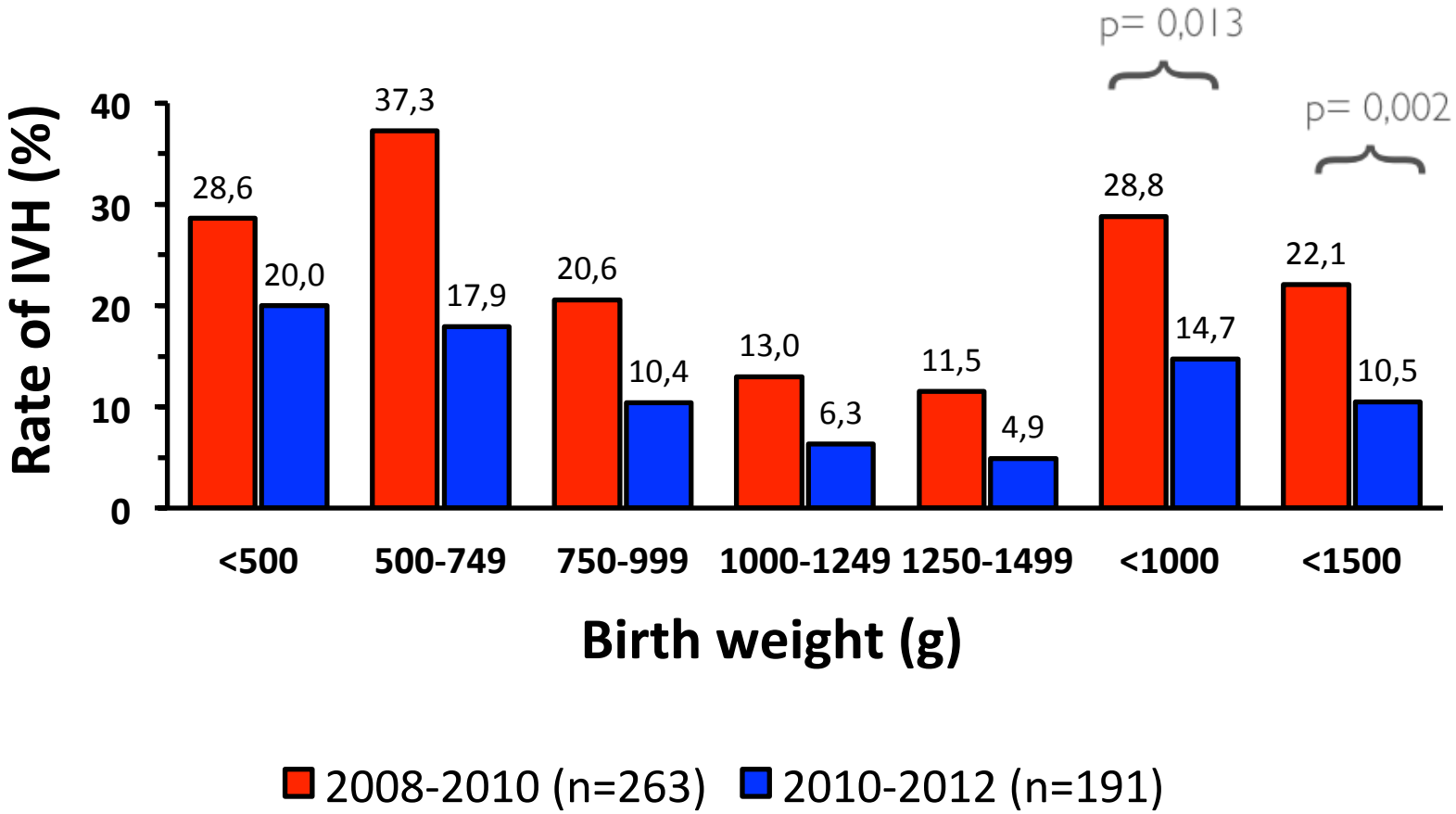
Different Grades - Before and After Intervention



Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Rate of IVH

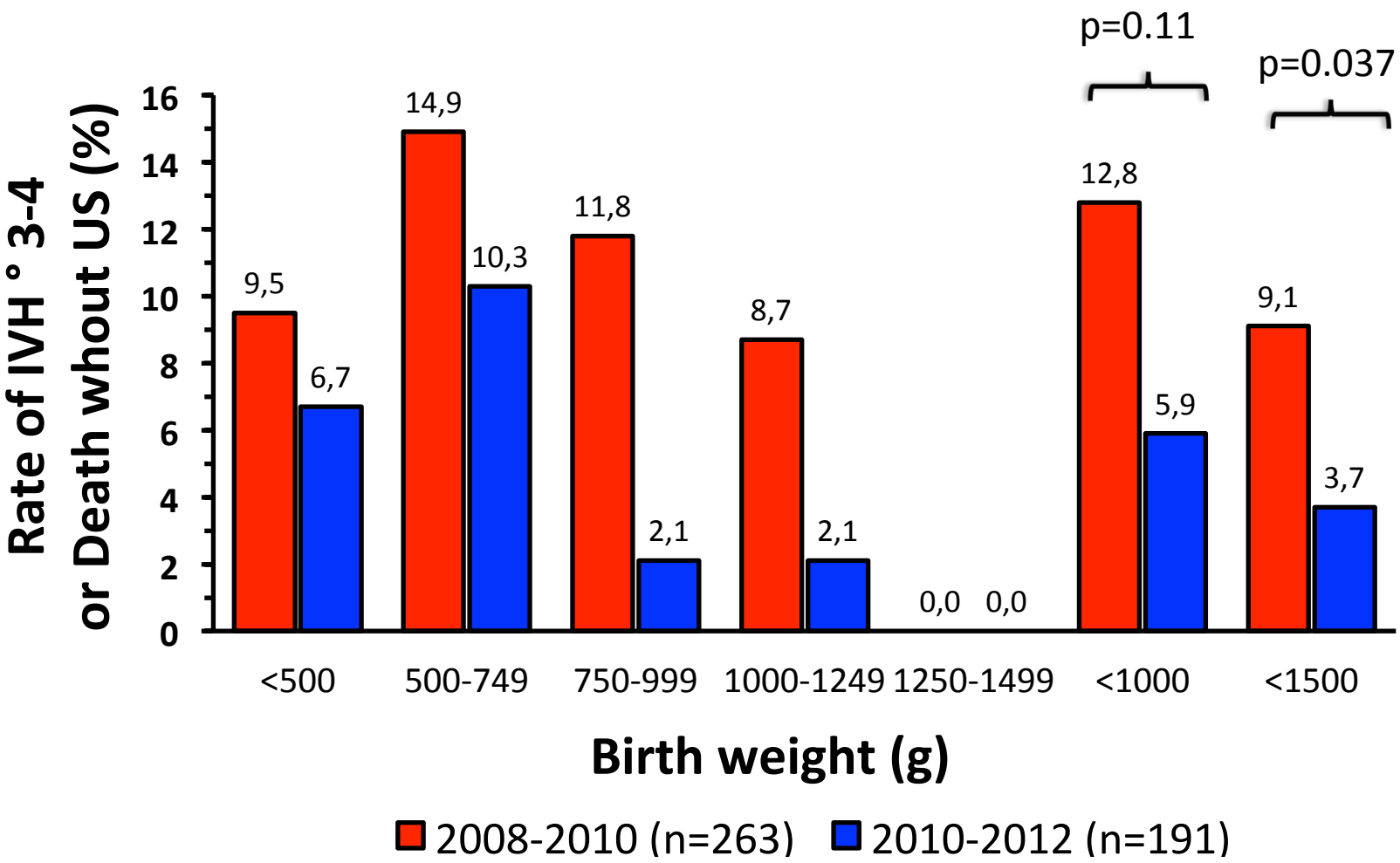
BW-Categories - Before and After Intervention



Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Rate of IVH Grade 3-4 (acc. to Papile 1978)

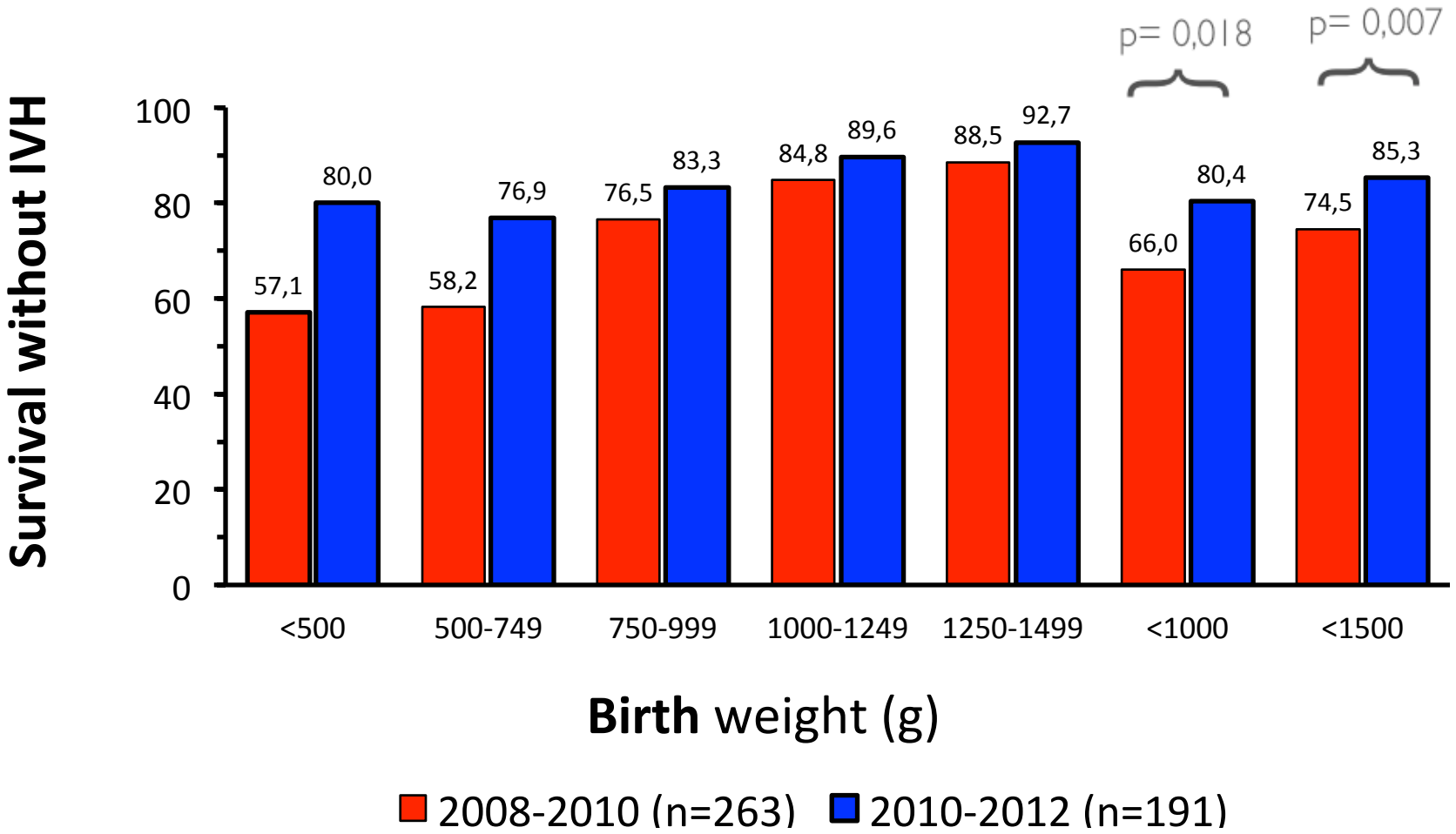
BW-Categories - Before and After Intervention



Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Survival without IVH

BW-Categories - Before and After Intervention



Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Results

Population Characteristics Before and After Intervention

	Before Intervention	After Intervention	Difference (95% KI)	P-value
Cesarean Section	83.3%	91.1%	+7.8% (1.5% – 14.2%)	0,023
Arterial cord-pH	7.32 (7.27 – 7.36)	7.34 (7.28 – 7.39)		0,024
Use of Catecholamines	50.6%	39.3%	-11.3% (-2.0% – -20.6%)	0,022
PDA-Ligation	10.3%	2.6%	-7.7% (-12.4% – -2.9%)	0,003
BPD (O_2@36 SSW)	10.6%	8.9%	-1.7% (-7.3% – 3.8%)	0,649
Postnatal Steroids	0.4%	0.5%	+0.1% (-10.9% – 13.8%)	0,624
Discharge with O_2	3.8%	2.6%	-1.2% (-4.51% – 2.2)	0,666
ROP + Laser	5.3%	5.2%	-0.1% (-0.10% – 0.08%)	0,908
NEC ≥ II°	3.4%	4.7%	1.3% (-2.3% – 4.9%)	0,651

Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

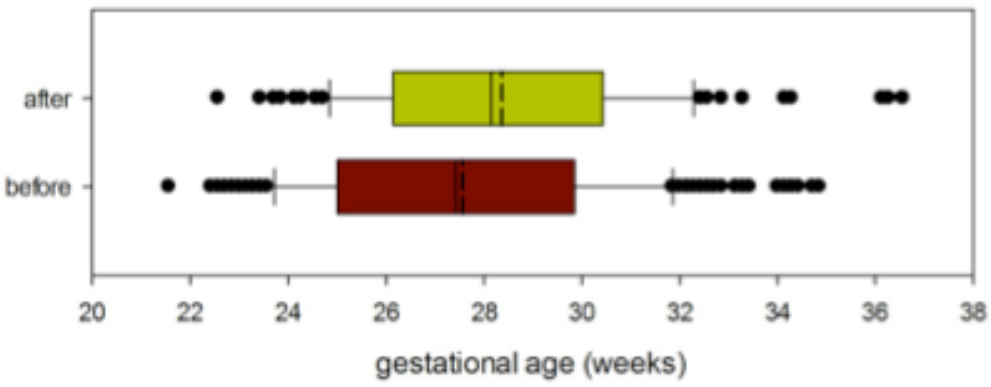
Results @ 2 Years

Population Characteristics Before and After Intervention

	Before Intervention	After Intervention	Difference (95% KI)	P-value
n (duration)	263 (31 months)	191 (23 months)		
GA Mean (SD)	27,6 ±3,0 wks	28,3 ±3,0 wks	+0,7 SSW (0,14-1,26)	0,014
BW Mean (SD)	936 ±315g	962 ±307g	+26g (-32g - 84g)	0,381
Any prenatal steroids	92 %	93,7 %	+1,7% (-3,1% - 6,5%)	0,612
male	54.4%	49.7%	-4.6% (-13.9% – 4.7%)	0,378
Multiple Gestation	29.7%	33.5%	+3.8% (-4.8% – 12.5%)	0,441
SGA	12.9%	12.6%	-0.4% (-6.6% – 5.9%)	0,977

Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

Logistic Regression
(to correct for differences in GA)



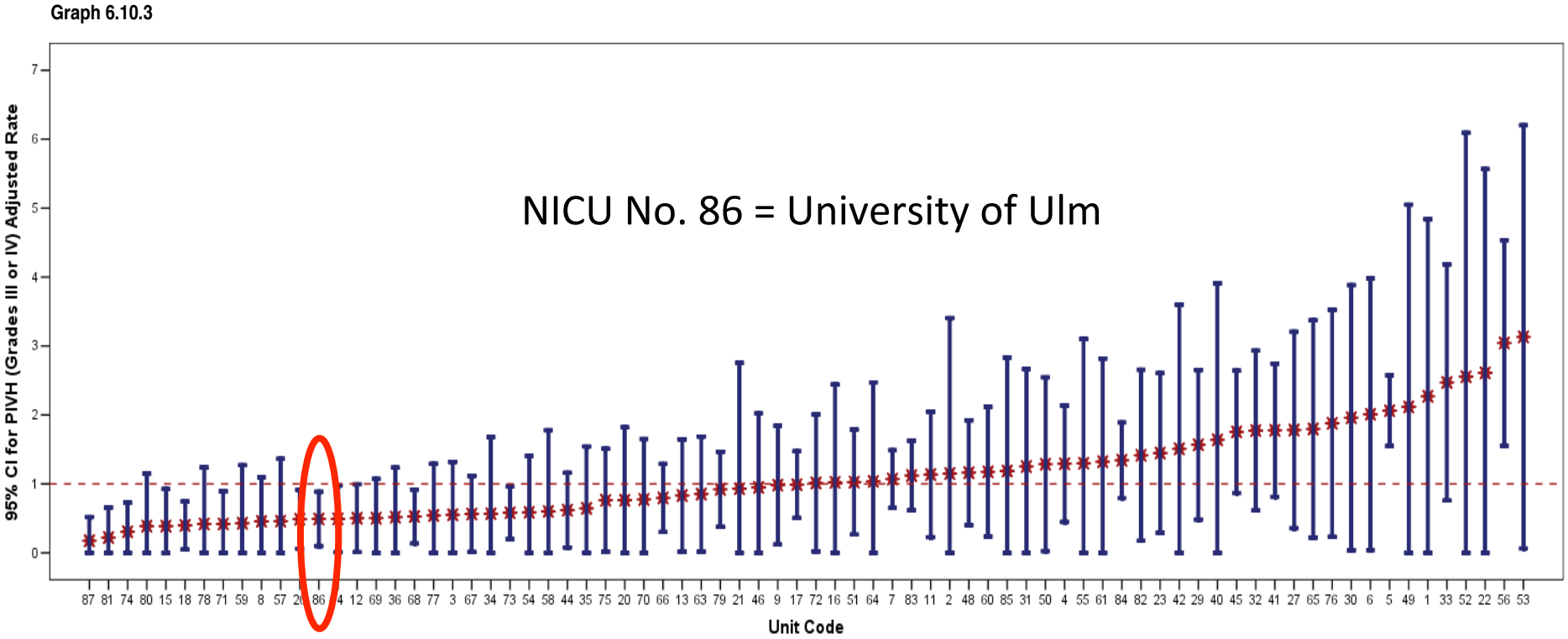
	GA Med. (IQR)
2010-2012	28.0 (26.0-30.3)
2008-2010	27.4 (25.4-29.9)
P-value	0.015

	Univariate Analysis		Logistic Regression after correction for GA	
	Odds Ratio (95% KI)	P-value	Odds Ratio (95% KI)	P-value
IVH	0.43 (0.25 – 0.73)	0.0018	0.49 (0.28 – 0.86)	0.013
Survival without IVH	1.95 (1.20 – 3.15)	0,0067	1.68 (1.01 – 2.81)	0.047
IVH III° or IV°	0.36 (0.14 – 0.89)	0.028	0.45 (0.17 – 1.17)	0.102

Schmid et al. Dtsch Arztebl Int. 2013 Jul;110(29-30):489-96. doi: 10.3238/arztebl.2013.0489. Epub 2013 Jul 22.

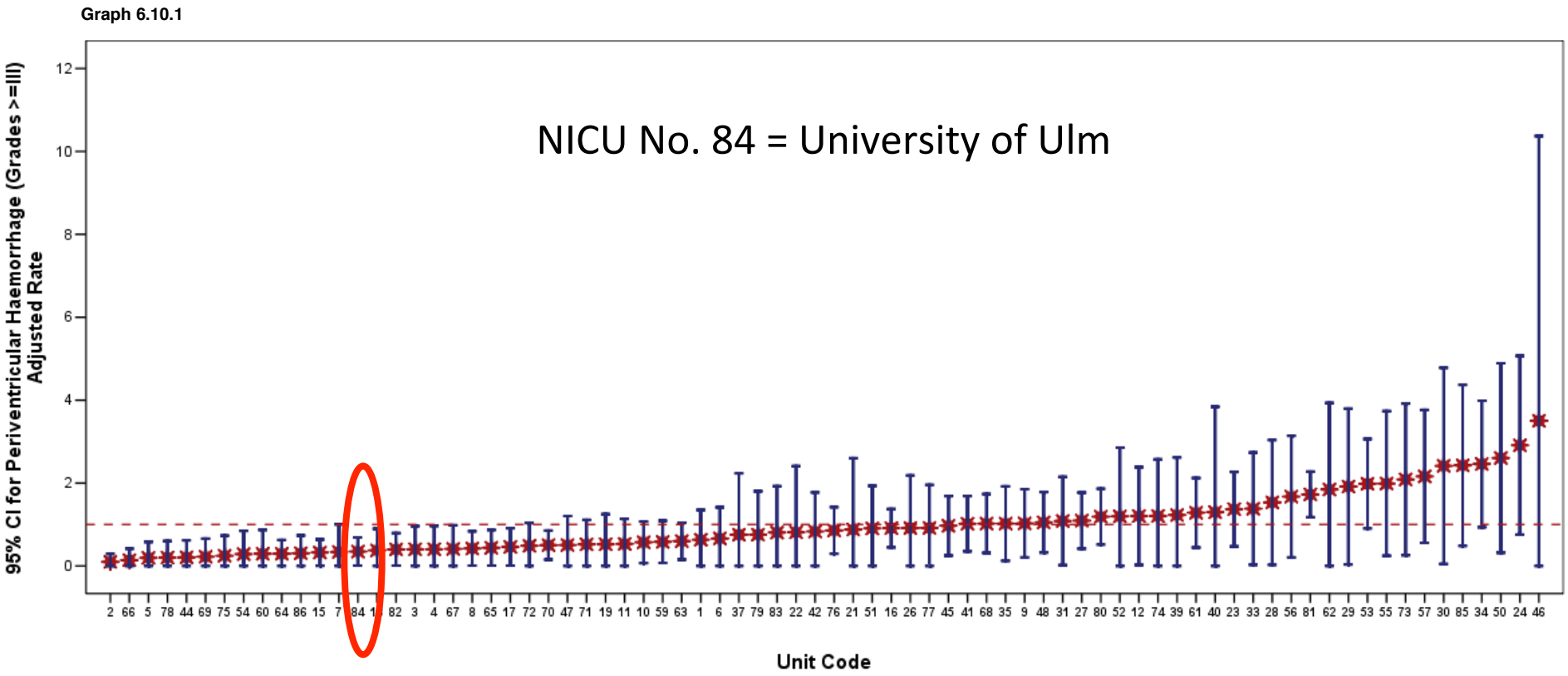
EuroNeoNet: Rate of IVH 2011

- Large variability in the rate of IVH
- adjusted for gestational age and gender



EuroNeoNet: Rate of IVH 2012

- Large variability in the rate of IVH
- adjusted for gestational age and gender



Summary

- EuroNeoNet provides useful information source on quality of care from a very diverse population of VLBWI in Europe
- Benchmarking using the EuroNeoNet can help to improve practice in neonatal care in European NICUs
- Participation in a neonatal network may be benefial to improve outcomes of VLBWI in individual NICUs (nosocomial infections, IVH, PTX ...)
  - Both from an individual NICU and from a more global perspective

Acknowledgements

- Preterm infants and their parents
- Investigators in 185 European NICUs in 17 countries
- Steering committee of EuroNeoNet
  (Mikko Hallman, Olivier Claris, Helmut Hummler, Marina Cuttini, Tom Stiris, Begoña Loureiro Gonzalez, José Ignacio Pijoán, Carmen Rosa Pallás, Javier de la Cruz, Stellan Hakansson, Gunnar Sjors, Djiem Liem, Michael Weindling, Nim Subhedar)
- Data coordination center, Bilbao, Spain
  (Agueda Azpeita Garcia and many others)
- Prof. Adolf Valls i Soler, MD
  - established and coordinated the EuroNeoNet initiative until 2013, passed away on the 20th of December 2013.