



Prenatal Cardiology and It`s Impact on Epidemiology of CHD



Jan Marek

Great Ormond Street Hospital
&
Institute of Cardiovascular Sciences,
University College London

No disclosures

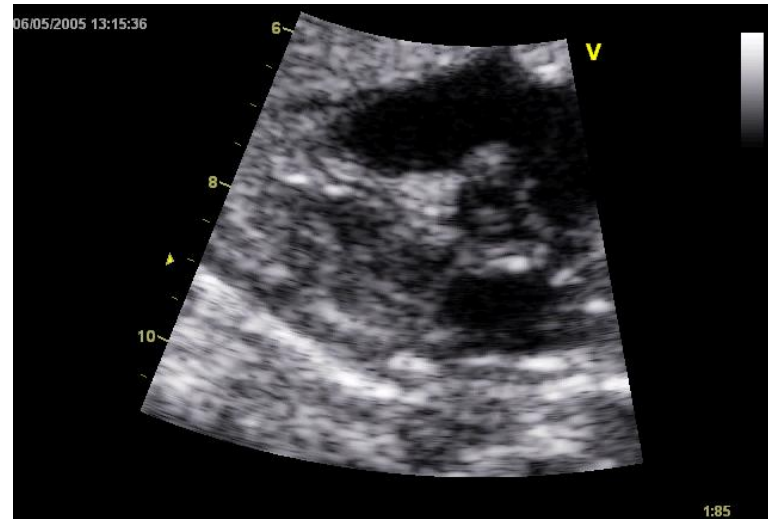
History of prenatal cardiology

- Subspecialty developed sec. to dramatic improvement in ultrasound cardiac imaging between 1980-1990
- Initially to detect cardiac abnormalities prior to delivery to :
 - a) offer early termination in severe forms of CHD
 - b) optimise delivery management in those with favorable outcome

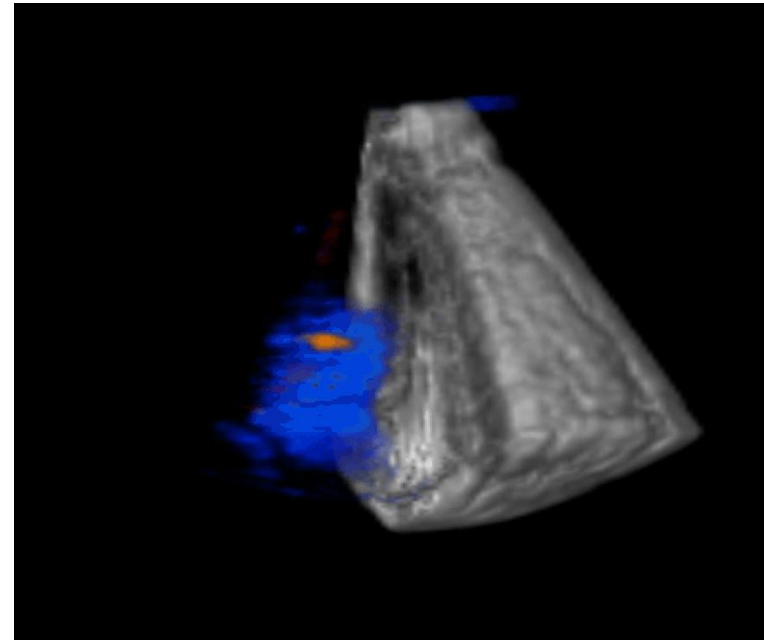
Prenatal ECHO over three decades



Wang XF, *Chinese J Obstet Gynecol* 1964;10:267



2010



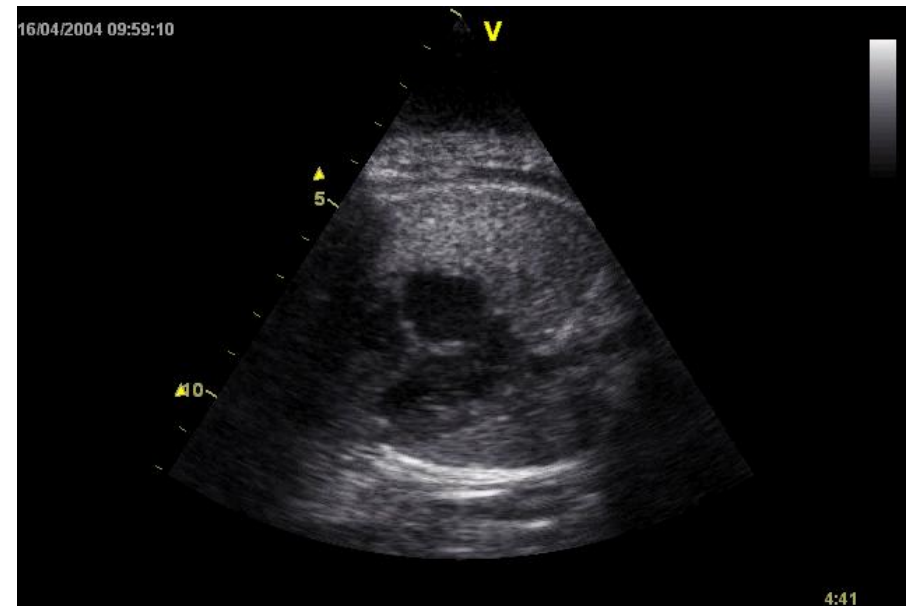
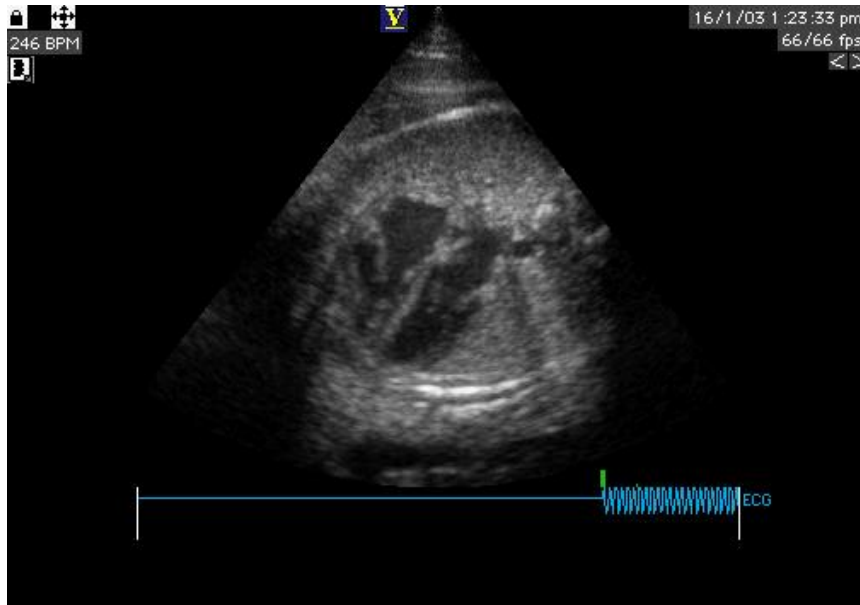
2015

Prenatal cardiology in 21st century

- Prenatal detection of major CHD from 11-14 weeks
- Epidemiology of CHD (prevalence)
- Natural history of disease (progressive/regressive)
- Prenatal prenatal treatment (structural, arrhythmia, heart failure)
- Management of delivery & postnatal treatment
- Family counselling and pregnancy planning
- Social / Economical impact on society

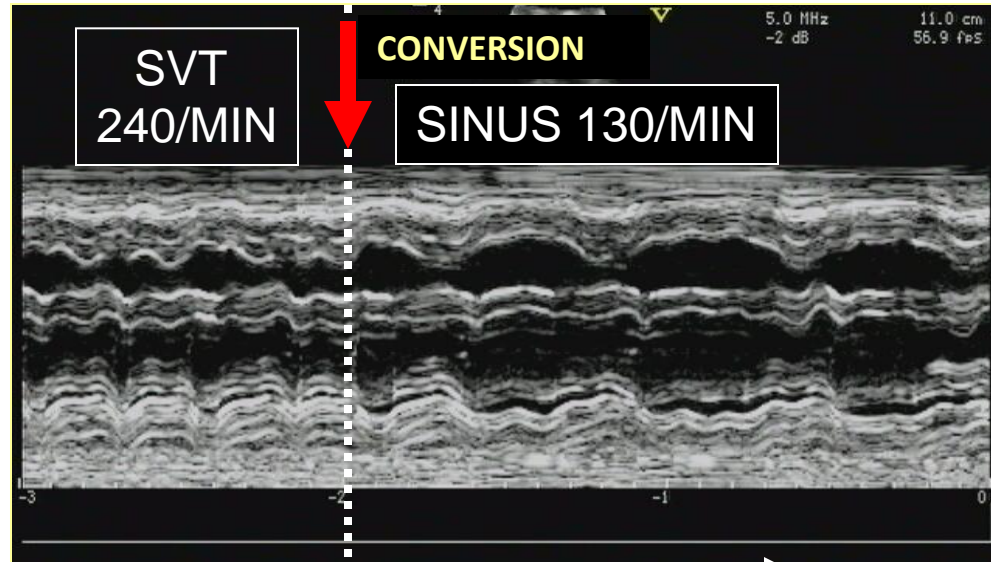
**Prenatal treatment of
sustained tachycardia:
life saving procedure !**

During fetal SVT, hemodynamic alteration results in rapid development of heart failure and hydrops fetalis

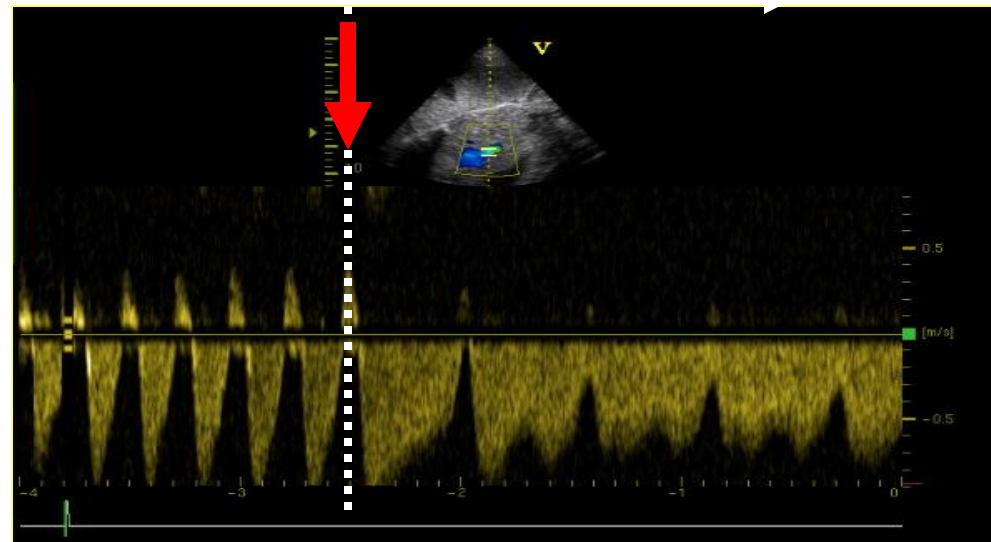


SVT: Pharmacological termination

RV+LV
M-Mode



Ductus
Venosus
PDE



Prenatal SVT

Current treatment options of SVT:

Digoxin (iv transmaternal, direct fetal)

Flecainide (oral transmaternal)

Amiodarone (oral transmaternal, direct fetal)

Sotalol (oral transmaternal)

Overall success to conversion ~90%

IU mortality <5%

Flecainide versus digoxin for fetal supraventricular tachycardia: Comparison of two drug treatment protocols

Shankar Sridharan, MRCPCH,* Ian Sullivan, FRACP,* Viktor Tomek, MD,†
 Joanne Wolfenden, PgDip Medical Ultrasound,* Jan Škovránek, MD, PhD,†
 Robert Yates, MBBCh, BSC MED, FRCP,* Jan Janoušek, MD, PhD,†
 Troy E. Dominguez, MD,* Jan Marek, MD, PhD, FESC*†

HeartRhythm 2016

From the *Great Ormond Street Hospital and Institute of Cardiovascular Sciences, UCL, London, United Kingdom, and †University Hospital Motol, Prague, Czech Republic.

Table 2 Outcomes: Conversion or rate control by treatment group

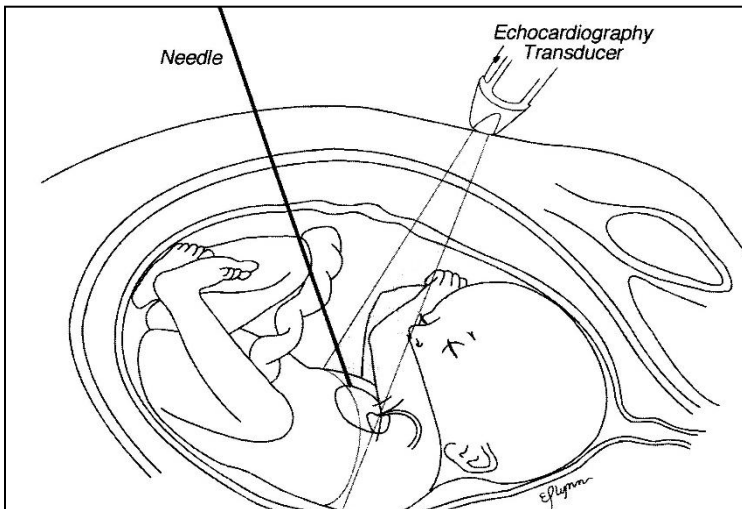
| | Flecainide (n = 34) | Digoxin (n = 50) | P value |
|--------------|---------------------|------------------|---------|
| Overall | 33/34 (97.1%) | 31/50 (62.0%) | .01 |
| SVT category | | | |
| Short VA | 27/27 (100%) | 20/21 (95.2%) | .01 |
| Long VA | 6/7 (85.7%) | 4/8 (50.0%) | .13 |
| Yes | 7/7 (100%) | 9/21 (38.1%) | .06 |
| No | 26/27 (96.0%) | 23/29 (79.0%) | .1 |

Changing clinical practice

SVT = supraventricular tachycardia; VA = ventriculoatrial.

**Fetal treatment options to
prevent from reverse
remodelation**

Aortic stenosis: Fetal intrauterine balloon valvuloplasty



Courtesy W. Tworetzky and G. Tulzer

Fetal aortic stenosis

Fetal intrauterine balloon valvuloplasty

- Preserved LV size in 17%
- Lower pulmonary hypertension
- Higher oxygen saturation

Potentially 200% mortality

- Fetal demise in 20%
- Fetal demise in 13%
- Ethical aspects

Prenatal screening of CHD

(~20 weeks of gestation)

- In countries with centralised health care
- All residents should be examined (~20 WoG)
- Financially covered by government

First programs for early detection of
CHD introduced in 1980 – 1990

Šamánek M, Břešťák M, Škovránek J 1986

Prenatal detection of CHD in Europe

| Country | CHD ALL / MAJOR | Demography |
|--------------------------------|--------------------|------------|
| Spain | / 52.6 % | Regional |
| Norway | / 24.2% | Regional |
| France | 47.3% / | National |
| France | / 90.2% | Regional |
| UK | 25.0% / | National |
| Czech R. | 30.2% / 80.7% | National |
| Scotland | 15.0% / 28.0% | Regional |
| Europe (EUROCAT, 12 countries) | 10-60% | Mixed |

Galindo A, Fet Diag Ther 2011

Khoshnood B, Pediatrics 2005

Marek J, Heart 2011

Tomek V, Physiol Res 2009

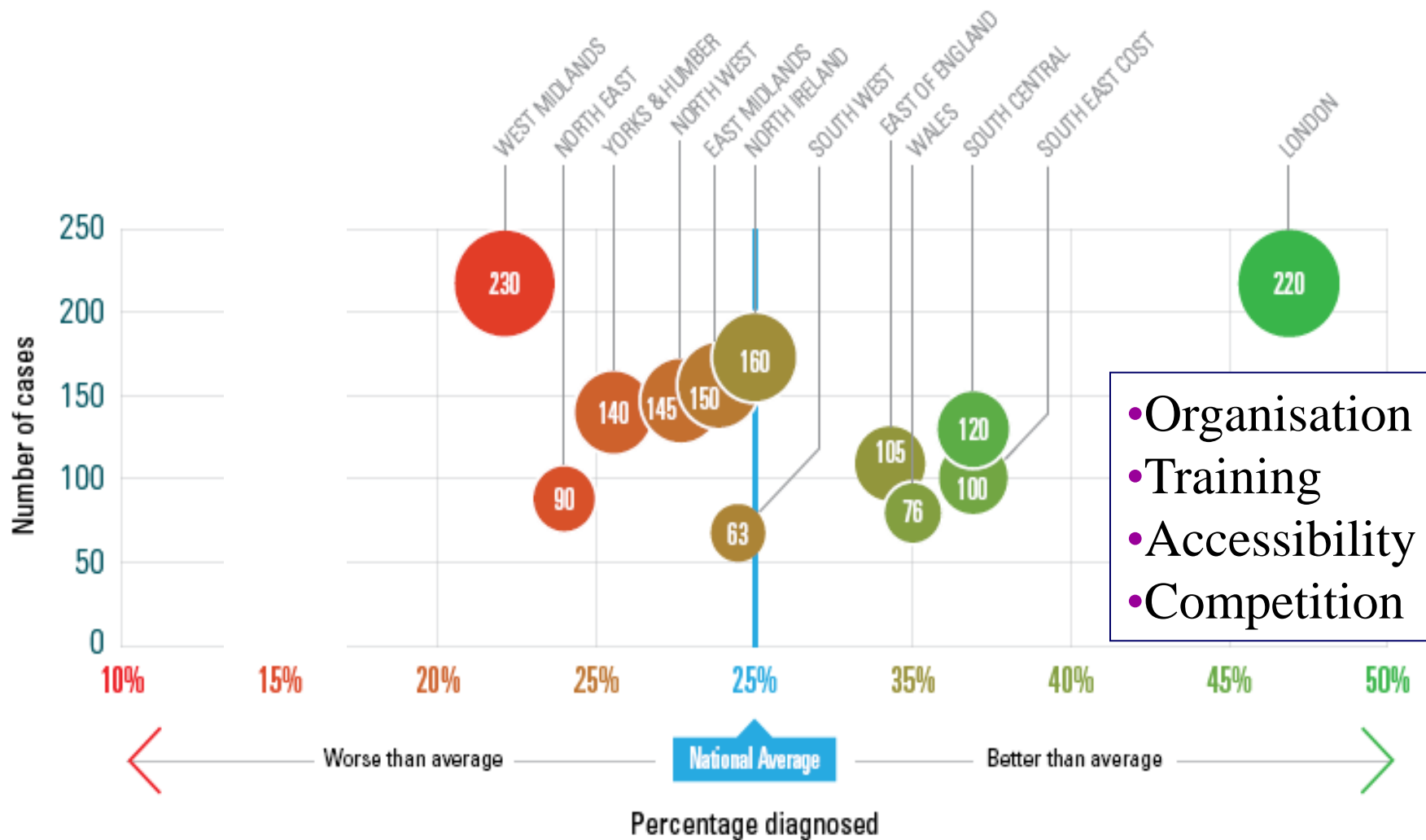
Acharya G, Acta Obst Gynecol Scand 2004

Safe & Sustainable 2011

Kilner H, Scot Med J 2011

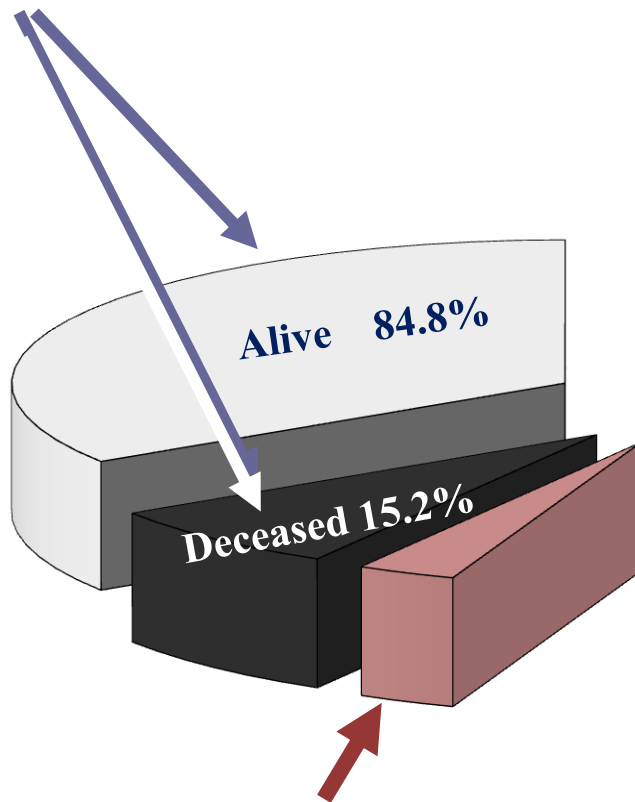
Garne E, Ultrasound Obstet Gynecol 2001

Antenatal detection rate of CHD in UK (S&S, 2004-2008)



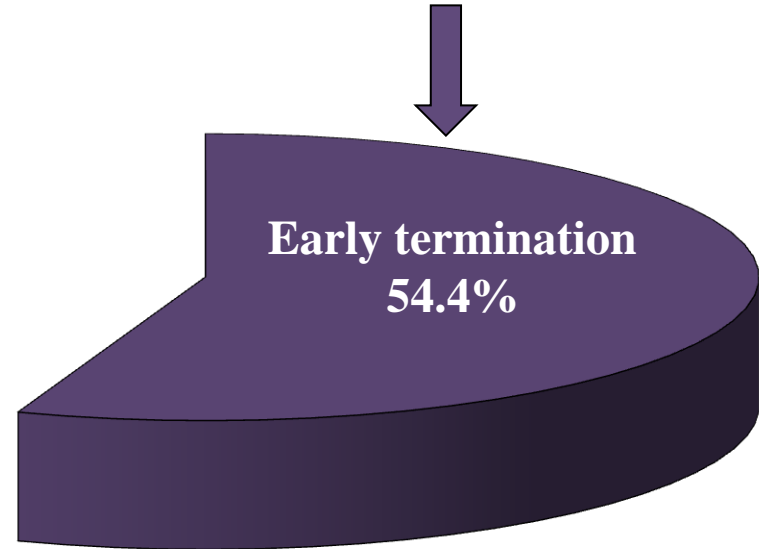
Outcome of antenatally diagnosed CHD Czech Republic, 1986-2011, N= 2 754)

Born alive 42.7%

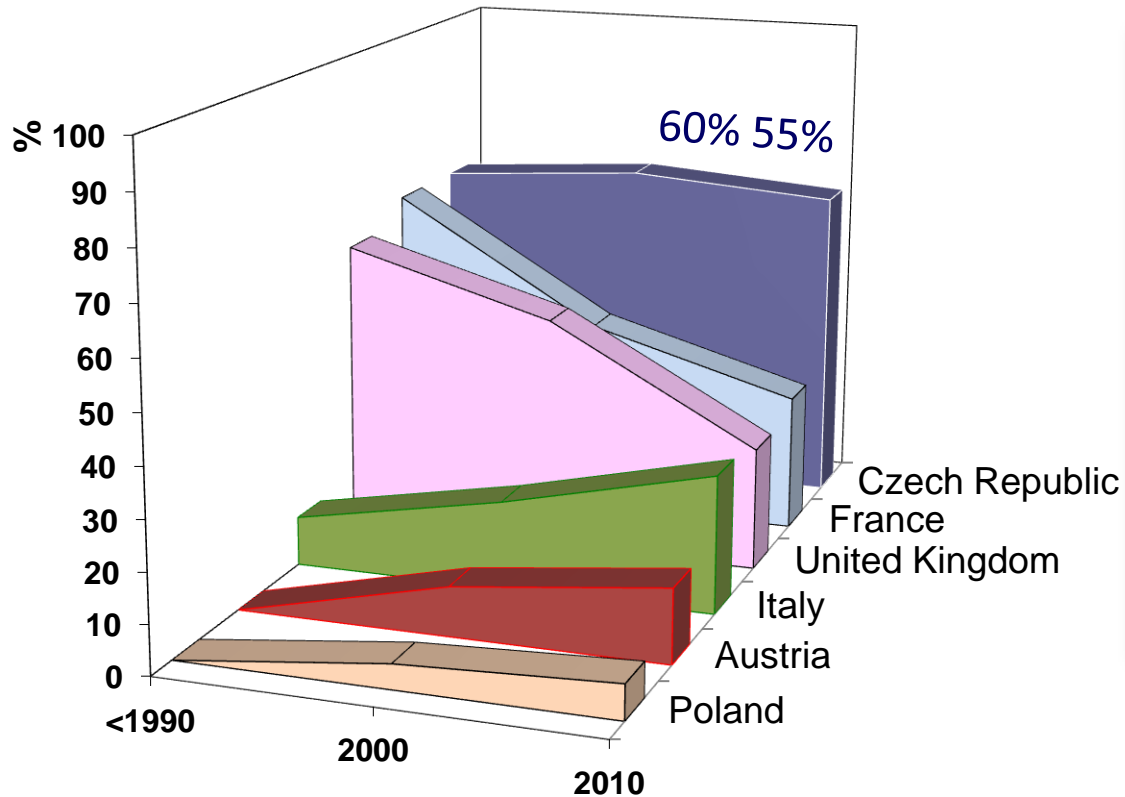


IU Death 2.9%
(6.7% from continuing pregnancies)

Additional comorbidity
incl. chromosomal 51%



Early termination of pregnancy (Europe, 1985-2010)



- Secular society
- Atheism 30%
- No confession 59%
- Pragmatic society
- Ethnically uniform
- Negligible migration
- Suboptimal social services



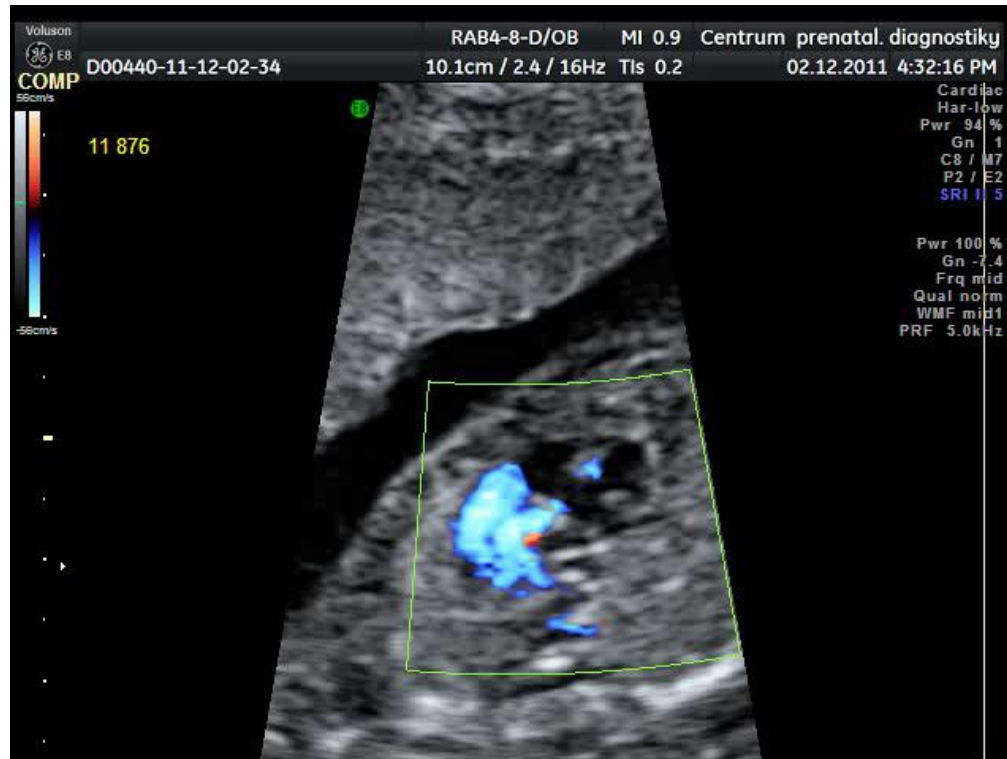
*Marek J et al, Heart 2011
AEPC databases 2011
Wikipedia 2015*

Rapid development in cardiac imaging improves the diagnosis



Moving to earlier gestational stages.....

**1st - trimester (<15th WoG)
ultrasound screening?**



Fetus 14.WoG
(TGA)

Courtesy H.Jicinska

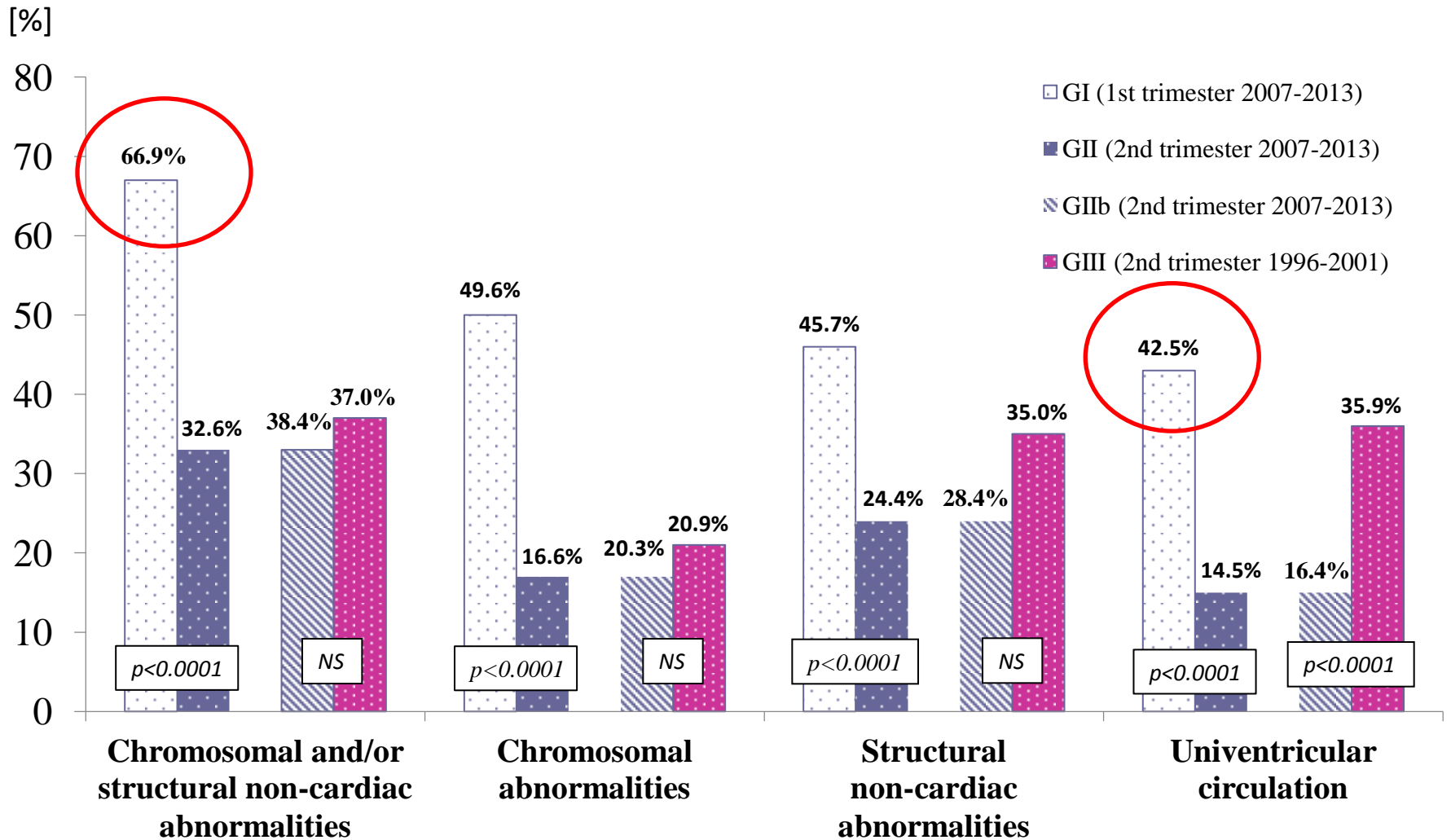
**Does First-Trimester Screening Modify the Natural History of Congenital Heart Disease?:
Analysis of Outcome of Regional Cardiac Screening at 2 Different Time Periods**
Hana Jicinska, Pavel Vlasin, Michal Jicinsky, Ilga Grochova, Viktor Tomek, Julia Volaufova,
Jan Skovranek and Jan Marek

Circulation 2017

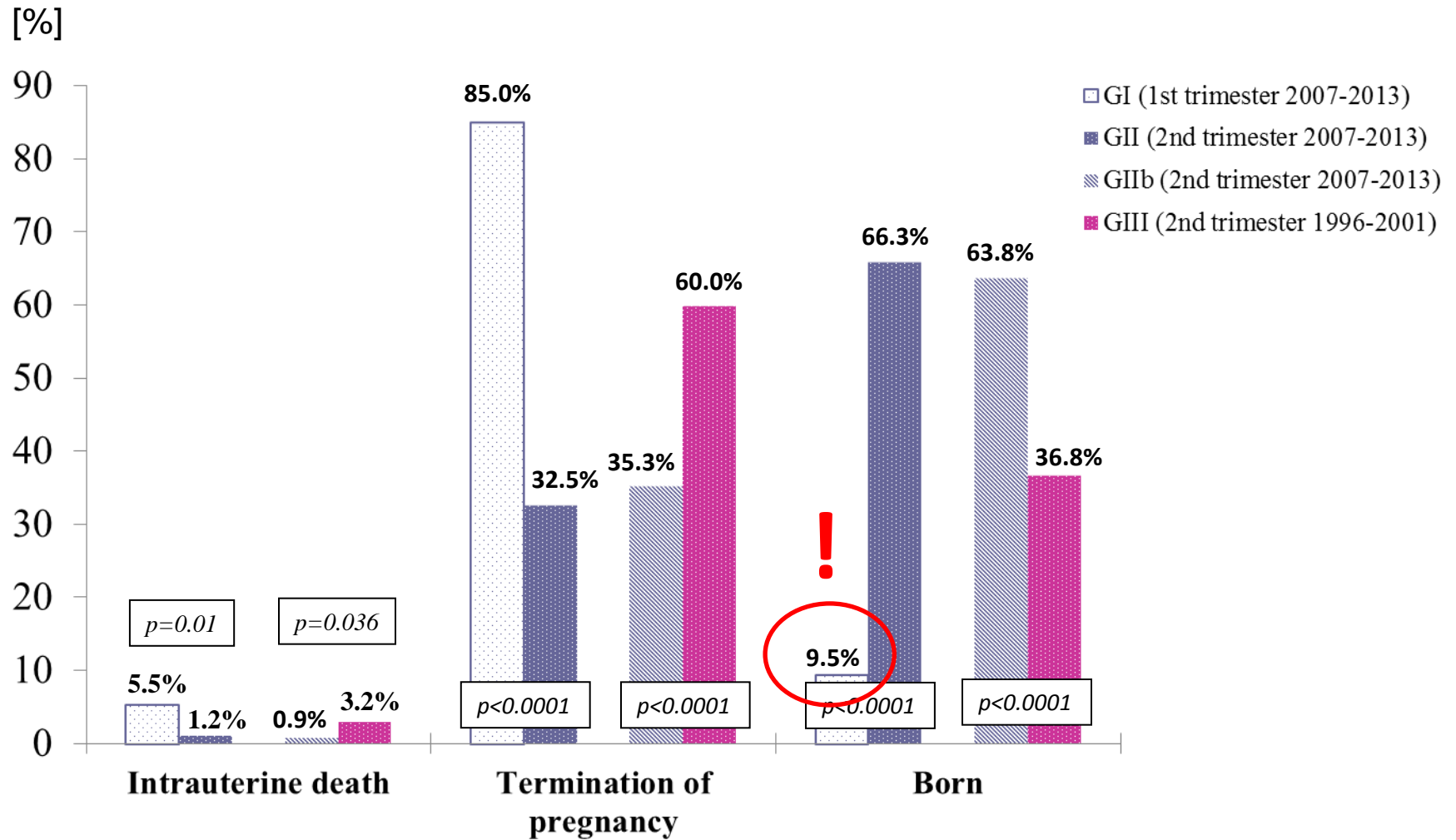
Impact of First-Trimester (11th -14th WoG) on Outcome of Antenatally Diagnosed Congenital Heart Disease

Regional prenatal screening
in Southern Bohemia region
of the Czech Republic

Associated comorbidity and type of circulation in 1st and 2nd trimesters from 2007 to 2013 and in 2nd trimester from 1996 to 2001



Outcome of fetuses with CHD diagnosed in 1st and 2nd trimesters from 2007 to 2013 in 2nd trimester from 1996 to 2001



Impact of 1st trimester fetal US screening

Cumulative detection rate of major aneuploidies **90%** (T+21 **98%**)
(*NT, biochemical screening, nasal bone, maternal age*)

Nicolaides HK, Fetal Diagn Ther 2011

Cardiac scans performed by fetal medicine specialist rather than cardiologist?

Fetal echocardiography at 11-13 weeks by transabdominal ultrasound
Obstetrician suspected 95 (95%) of the 100 CHD identified by fetal cardiologist

Belotti M, Ultrasound Obstet Gynecol 2010

Persico N, Ultrasound Obstet Gynecol, 2011

Trained fetal sonographer can perform a fetal heart study during the NT screening test using transabdominal high-resolution transducers **in an acceptable length of time**

Lombardi CM, Ultrasound Obstet Gynecol, 2007

Highest cost-benefit ratio and most efficacious protocol for screening would be **comprehensive fetal US** with prenatal and postnatal ECHO only as indicated

Bernard LS, Ultrasound Obstet Gynecol 2009

Implementation of 1st trimester screening

... 1st trimester enables to detect serious CHD and those associated with comorbidity...

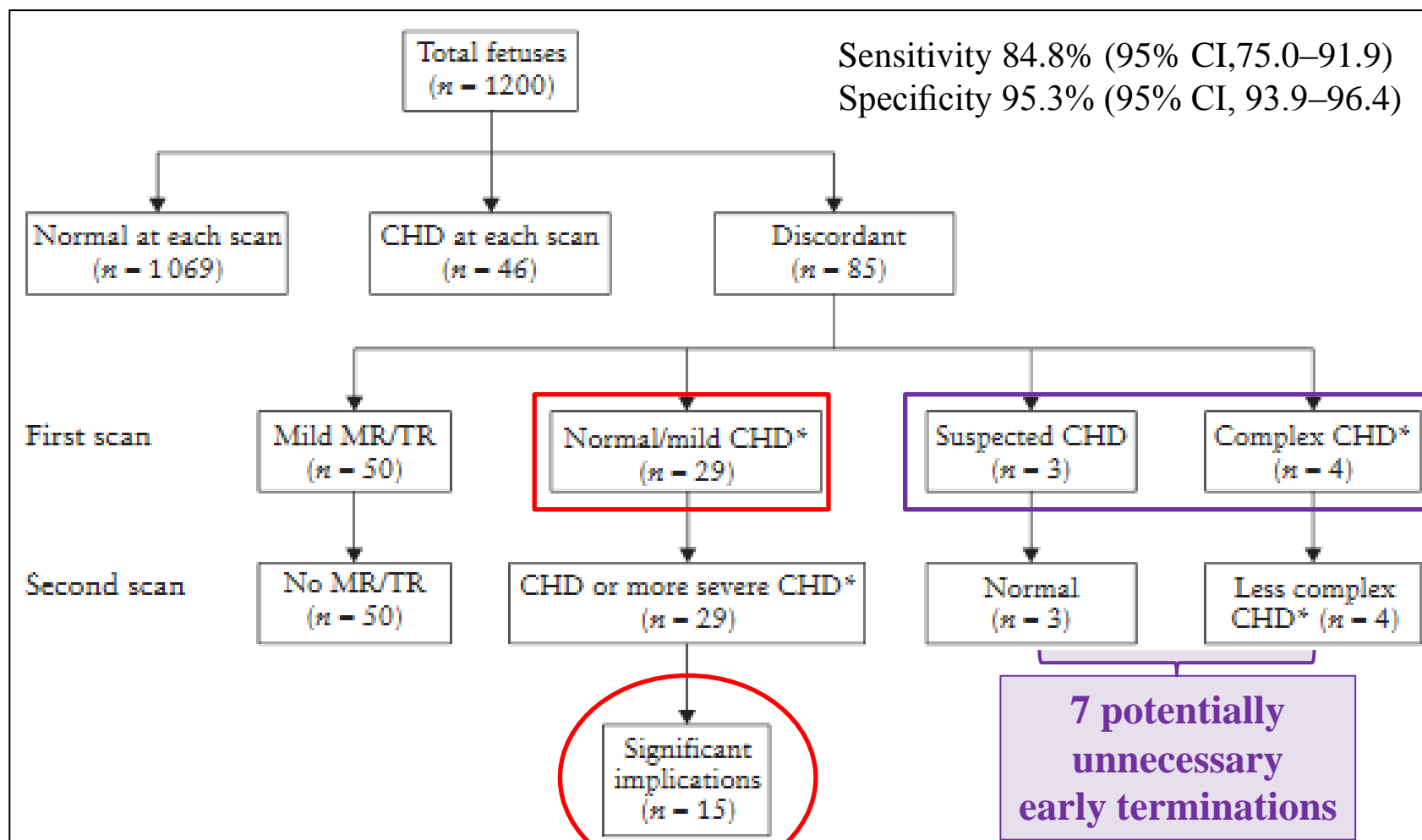
....at what price?!

- The **heart too small** to correctly classify CHD
- **Natural history often unknown** (progressive or regressive?)
- Counseling even by cardiologist may offer **incomplete or false outcome prediction**
- **Counseling given by fetal medicine specialists or gynaecologist** rather than cardiologist ...

...catastrophic consequences

Comparison of echocardiographic findings in fetuses at less than 15 weeks' gestation with later cardiac evaluation

1,200 scans <15 weeks vs >21 weeks



Implementation of 1st trimester screening in the Czech Republic

- **High detection rate** of structural and chromosomal abnormalities diagnosed antenatally
- **High early termination rate**



- **Significant reduction of children born with congenital abnormalities**
- **Impact on cardiology services (Paediatric)**
Impact on quality of provided services?
(170 bypass/surgeon/year)
Limited education, research?

Changing social behaviour in developed countries in 21st century

‘Welfare’ of Western Society

- Overall reduction in birth-rate

+

- Increasing age of primiparas

(21yrs in 1980 → 30yrs in 2010 in Czech R., 34yrs in UK)

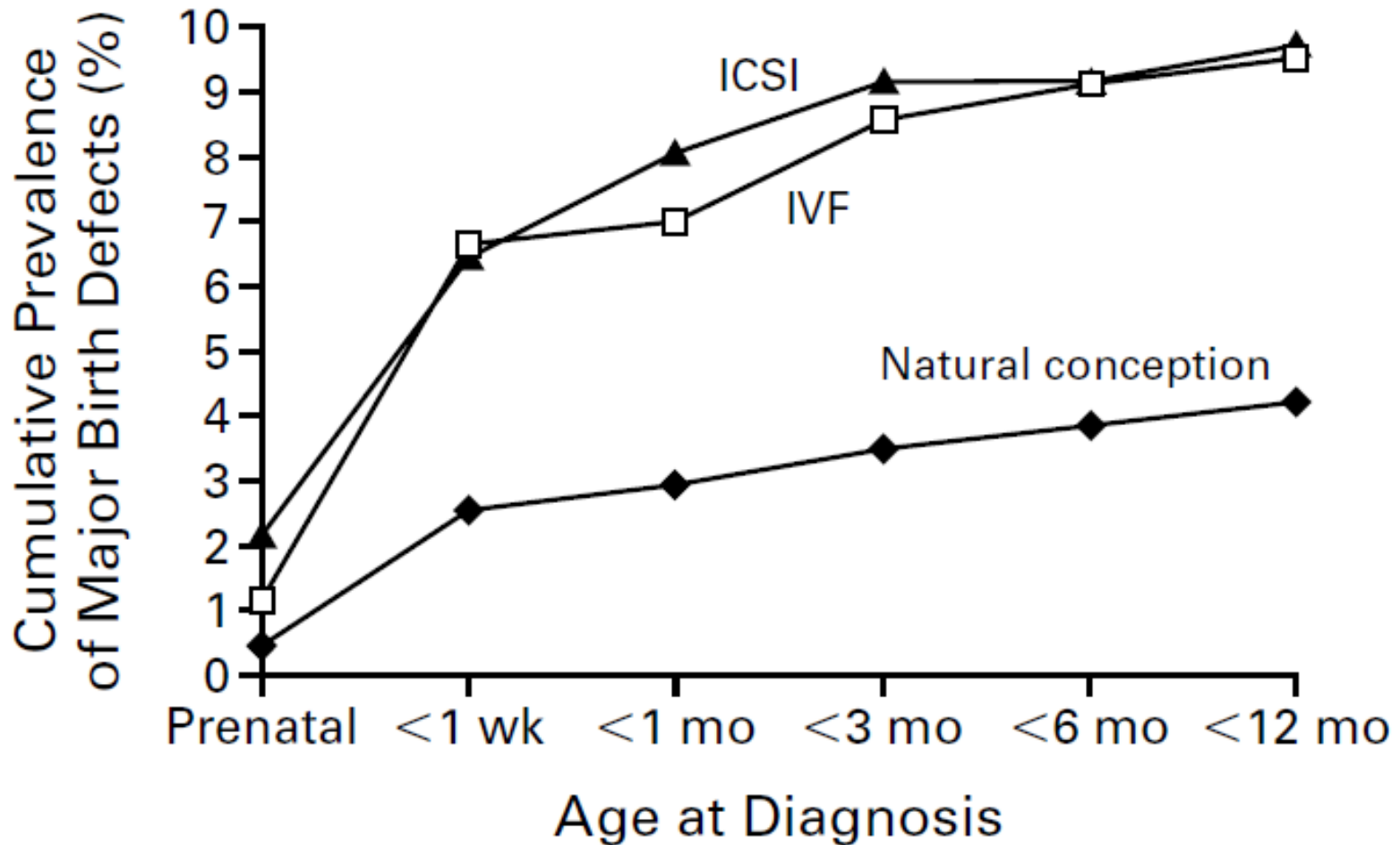


- Increased numbers of AR pregnancies



Increased prevalence of congenital defects?

Cumulative prevalence of major defects by age



...Infants conceived with use of ICSI or IVF have twice as high a risk of a major birth defect as naturally conceived infants

Hansen M, NEJM 2002

- Are we ‘programmed’ for having a healthy child at >40 years old?
- Will cyto-molecular genetics sort everything for us?
- Implication on Western Society?
- What legacy we leave for future generations?

Prenatal Cardiology

Team Czech



- Milan Šamánek
- Jan Škovránek
- Viktor Tomek
- Hana Jičínská
- Viera Povýšilová
- Bója Ošťádal

& Paediatric Cardiologists
& Obstetricians &
Gynaecologists

Team GB



- Ian Sullivan
- Nicky Manning
- Michelle Carr
- Jo Wolfenden
- Robert Yates
- Rachel Andrews
- Shankar Sridharan
- Miranda Porrit
- Nicola Callaghan

& Fetal Medicine Team
& Palliative Team
& Paediatric Cardiologists