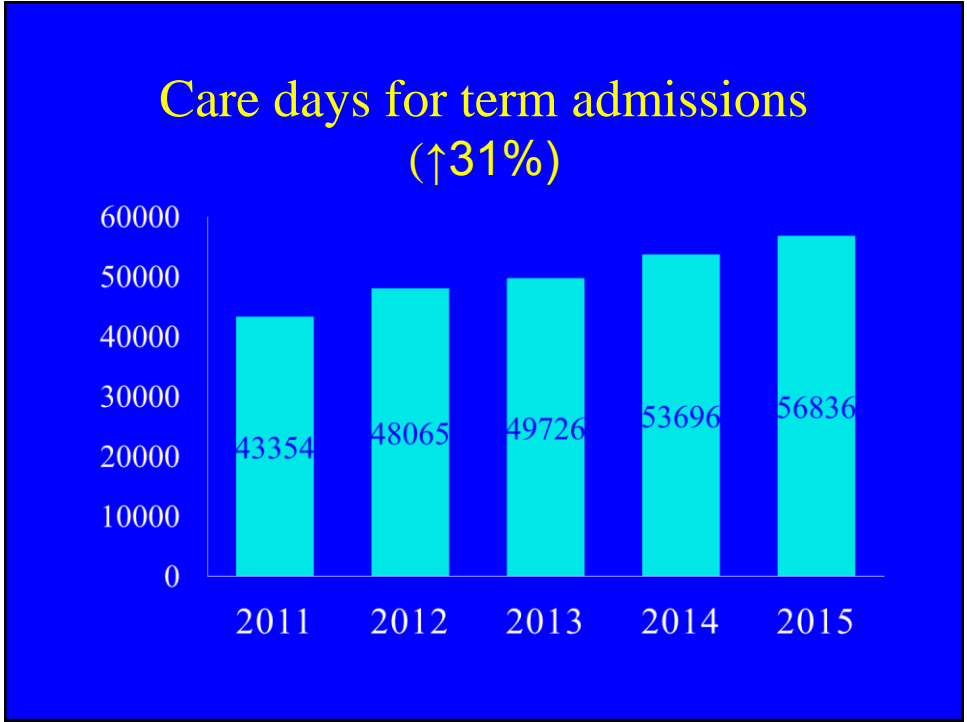
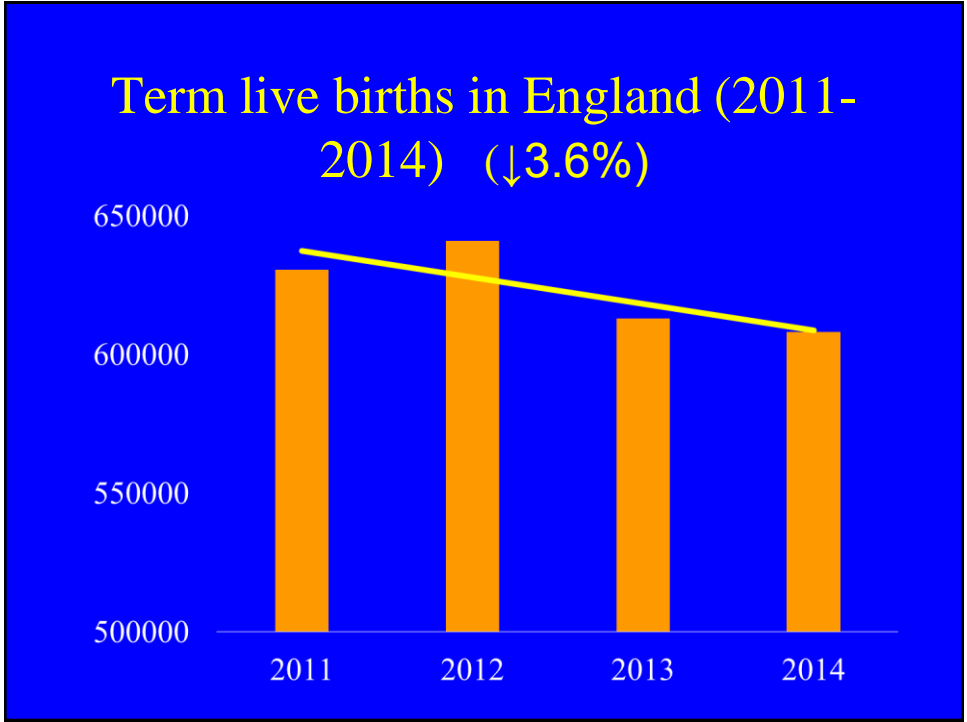




## RESOURCE ALERT

<https://improvement.nhs.uk/resources/preventing-avoidable-admissions-full-term-babies/>

Atain programme



## Why is this important

- Effects of infant maternal separation at birth profound and can be lasting
- Significant but avoidable cost to NHS, families
- Signal of sub optimal care during antenatal, intrapartum or post natal period
- Signal of inappropriate policies or failure to apply suitable policies

5

## RESUSCITATION AFTER FETAL HYPOXIA-ISCHAEMIA

- Staff present with appropriate competence
- ABCD
- Start with air
- When to stop
- Communication
- Documentation
- Simulation training

## ROLE OF THERAPEUTIC HYPOTHERMIA

- Acute profound hypoxia-ischaemia
- Standard of care since 2010
- Early passive
- Active in specialist centre
- 30% reduction in adverse outcome

## PERINATAL STROKE

- Associated with complications of labour and delivery but causal link unknown
- Rare blood disorder
- May be silent
- Clinical signs not specific

## NEONATAL INFECTION

- NICE guidance 2012
- GBS, Gram negative, herpes simplex
- Antenatal, intrapartum, postnatal acquisition
- Early signs very subtle
- Associated pathology
- Narrow therapeutic window
- Low threshold to screen and treat

## NEONATAL JAUNDICE

- NICE guidance 2010
- Gestation specific thresholds
- Clinical signs may be subtle
- Often narrow therapeutic window
- But placing by a window not effective
- Underlying pathology esp meningitis
- Kernicterus – hearing, basal ganglia

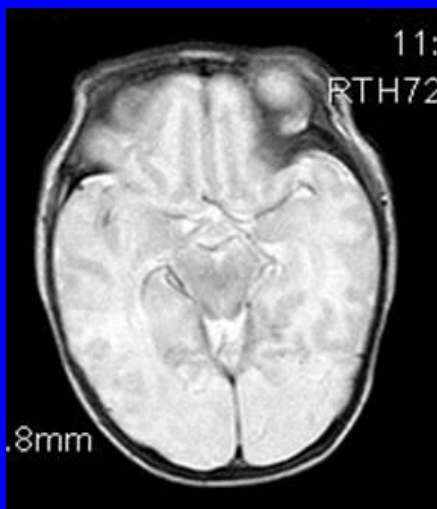
## NEONATAL METABOLIC ADAPTATION

1. Blood glucose control
2. Alternative fuels -  
lactate, ketone bodies

## Hypoglycaemia and brain injury.

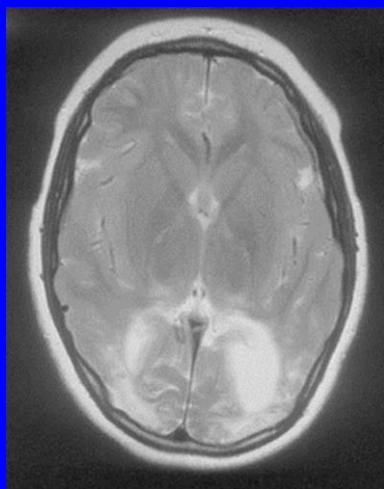
1920s	Insulin overdose in adults
1933	Insulin treatment of psychiatric disorder 30 mins hypoglycaemic coma
1950s	Neuronal necrosis demonstrated
Present	Insulin, OHAs - treatment error or self harm Insulin producing tumours and IEMs Failure of metabolic adaptation

**Imaging – acute (courtesy of Dr N Stoodley)**



Term baby, 5 days, admitted at 3 days poor feeding, fitting, unrecordable blood glucose.  
Increased parenchymal signal and loss grey-white matter differentiation in posterior parietal and occipital regions

**Imaging – long term (courtesy of Dr N Stoodley)**



Imaging on childhood following neonatal hypoglycaemia  
Atrophy, gliosis and ulegyria in posterior parietal and occipital regions

## Adverse neurodevelopmental outcome of moderate neonatal hypoglycaemia

661 infants

6808 samples

Bwt 1337g (315)

Gest 30.5 (2.7)

Age 48hrs - 8 weeks

Causal relationship with signs in 5

Lucas et al, 1998

## Occurrence of hypoglycaemia

	Plasma glucose (mmol/l)		
	<0.6	<1.6	<2.6
Overall	10%	28%	66%*
On 1 day	8%	20%	32%
On 2 days	1%	4%	18%
On $\geq 3$ days	1%	4%	16%**

Variation between centres:

\* 53-79%

\*\* 4-31%

Lucas et al, 1998



## Factors associated with hypoglycaemia

- Neonatal unit
- Apgar 5 < 5
- Bwt <1000g
- SGA

Lucas et al, 1998

## Regression analysis

Dependent variables: Bayley motor and developmental scales

Independent variables: Days hypoglycaemia\*  
Sex  
Birthweight  
<10th centile  
Gestation <30/40  
Clinical complications\*  
SBR >170  
Apgar 5 <5  
Social and educational\*

Lucas et al, 1998

## Relative risk of neurodevelopmental impairment (Bayley score $\leq 70$ or CP)

Days hypoglycaemia	Adjusted RR
0	1
1-2	1.1
3-4	2.2
> 5	3.5 (1.3-9.4)

Lucas et al, 1998

## Hyperinsulinaemic newborn monkeys

Pre and post delivery sub cut insulin by pump  
Not fed after birth

Tested 8 months:

Pre-training - emotionality and adaptability

Matching to sample tasks

Delayed matching to sample - memory

Schrier et al, 1990

## Hyperinsulinaemic newborn monkeys

Results:

10 hr hypo -

- more training difficulties
- more procedural alterations (adaptability)
- additional help from tutors (motivation)

No differences in -

- completion of tasks (with extra attention)
- personality characteristics
- neurology

Schrier et al, 1990

## Operational thresholds

- The concentration of plasma or whole blood glucose at which intervention should be considered to increase the glucose level.

## Operational thresholds

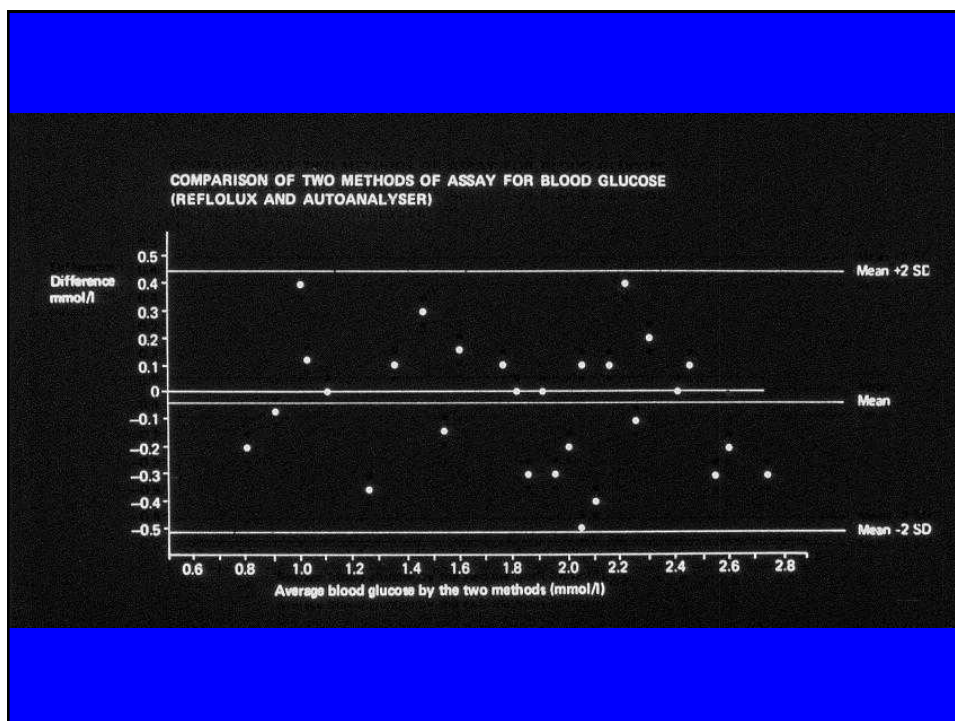
Infants with clinical signs:

2.5 mmol/l

Infants at risk:

Persistently  $<2.0$  mmol/l

$<1.0$  mmol/l at any time



## Neonatal hypoglycaemia?

38 weeks

Labetalol in pregnancy and postnatal

Fetal distress in labour, NVD

Placenta small and gritty

Good condition, no resuscitation

Birthweight 2192g (2nd centile)

Head circumference 33cm (25<sup>th</sup>-50<sup>th</sup> centile)

## Neonatal hypoglycaemia?

1hr: paed informed of weight, "watch feeding and temperature"

11 hours: paed examination normal

14 hours: discharged

28 hours: MW visit, baby floppy and unresponsive, cardioresp depression

28.5 hours: NNU, BM unrecordable, cardiac arrest, fits, renal impairment

## Neonatal hypoglycaemia?

Follow up:

MRI: parieto-occipital cortical and white matter injury

Global developmental delay

Autistic features

## Neonatal hypoglycaemia?

37 weeks

Emergency CS for breech

Meconium stained liquor

Good condition, no resuscitation

Birthweight 2900g (50<sup>th</sup>-75<sup>th</sup> centile)

Head circumference 34cm (75<sup>th</sup>-91<sup>st</sup> centile)

## Neonatal hypoglycaemia?

Meconium obs normal, discontinued

Support to attach at breast

12 hours: unsettled not feeding, EBM by syringe

16 hours: lethargic, placed skin to skin, would  
not suck, gasping, paed informed

16.5 hours: BM unrecordable, paed attended, NNU

17 hours: cardiorespiratory arrest x 3, fits, renal  
impairment

## Neonatal hypoglycaemia?

Follow up:

MRI: injury to basal ganglia, cortex, white matter

Very long chain acyl coA dehydrogenase deficiency

Microcephaly, epilepsy and severe disability

## Neonatal hypoglycaemia?

37 weeks

Diet controlled gestational diabetes

Emergency CS for CTG abnormalities

Good condition, no resuscitation

Birthweight 2566g (25th centile)

Head circumference 33cm (25th centile)

## Neonatal hypoglycaemia?

Planned to breast fed

18 hours - not fed, sleepy

BG 0.4mmol/l

Took bottle slowly, remained sleepy

BG 1.4mmol/l

Admitted NNU

IV glucose, infection screen



## Neonatal hypoglycaemia?

Age (hrs)	BG (mmol/l)
18	0.4
19	1.4
20	1.6
21	3.7
25	5.8

## Neonatal hypoglycaemia?

BG	1.8 mmol/l
Ammonia	112 umol/l
Cortisol	87 nmol/l
TSH	3.27 mU/l
Thyroxine	30.3 pmol/l
Insulin	<1.0 mU/l
BOH	533 umol/l
Acac	234 umol/l
Organic acids, amino acids, carnitine profile - normal	
Infection screen negative	

## Neonatal hypoglycaemia?

Maximum glucose requirement 6mg/kg/min

Remained sleepy until day 4

No further low BG

Day 2 - EBM tube feeds commenced

Day 3 - Successfully weaned from iv glucose

Day 4 - Fully breast/cup fed (pulled tube out)

Follow up - no neurodevelopmental concerns

## Infants at risk of abnormal neonatal metabolic adaptation

- **Altered maternal metabolism**
  - intrapartum administration of glucose
  - maternal drug treatment
  - diabetes
- **Secondary to neonatal complications**
  - infection
  - polycythaemia
  - perinatal hypoxia-ischaemia
  - hypothermia
  - prematurity
- **IUGR**
- **Neonatal hyperinsulinism – transient or prolonged.**
- **Endocrine disorders**
- **Inborn errors of metabolism**

## Blood glucose and brain injury The evidence

Healthy full term	None
Preterm	Prolonged hypoglycaemia Confounding factors
IUGR	None direct ? ADD
Prolonged with signs	Cortical loss, global delay

## Clinical recommendations Healthy, term, AGA babies

- Support breast feeding
- No routine blood glucose monitoring

## Clinical recommendations Very preterm or sick babies

- Regular glucose monitoring
- Milk or IV glucose to maintain BG >2.5mmol/l
- Expressed breast milk as tolerated

## Clinical recommendations Small or vulnerable babies

- Support breast feeding
- Maintain rigorous clinical monitoring
- Expressed breast milk or formula supplements according to clinical signs and BG

And above all:  
**Identify and document**

- Risk factors
- Coexisting conditions
- Clinical signs/ normality
- Accurate blood glucose measurements
- Response to treatment
- Investigations for underlying pathology