Qatar is populated by original Qatari tribes (Arabs) that add up to about 200.000 people and about 600.000 foreign workers mainly from Asian countries.

In the Qatari population and in some groups of foreign workers consanguineous marriage is highly prevalent.
It is common to marry a 1st or 2nd degree relative .
The rate of consanguinity in Qatar is (> 54%) (Bener et al 2005)..

About 13.000 neonates per year

In 2003 The Health Authority in Qatar decided to implement a newborn screening program to screen for metabolic and endocrine disorders.
At that time Qatar had no laboratory facilities to implement this program.
The University Children's Hospital of Heidelberg was chosen as the partner for the project.

The goal was
- ***To Screen all babies born in Qatar.***
- ***To timely identify children with metabolic diseases.***
- ***To improve the availability of management and follow-up services.***

All Hospitals were involved in the program.

A functioning infrastructure between Doha and Heidelberg (about 6000 km apart) for the rapid transfer of test cards till the rapid communication of results was established.

The number of disorders to be included in a newborn screening program will depend on the ethnic background, customs, social characteristics, medical environment and economic status of the country (Fang-Hoffmann et al 2006).

The initial screening panel that was offered by the University Children's Hospital of Heidelberg and are currently screened for are shown in the following table :

Disorders integrated into the extended neonatal screening in Qatar

Group	Disorder
Endocrinopathies	Congenital hypothyroidism Congenital adrenal hyperplasia
Aminoacidopathies and urea cycle disorders	PKU, HPA, BS MSUD HCY Tyrosinaemia type I Citrullinaemia Argininosuccinicaciduria
Organic acidurias	Methylmalonic aciduria (Cbl-disorders) Propionic aciduria Glutaric aciduria type I Isovaleric aciduria 3-Methylcrotonylglycinuria MAD IBDH deficiency
Fatty acid oxidation disorders, carnitine cycle defects and disorders of ketogenesis	MCAD deficiency VLCAD deficiency LCHAD/mTFP deficiency SCAD deficiency Carnitine transporter deficiency CPT-I, -II HMG-CoA lyase deficiency Ketothiolase deficiencies
Others	Classical galactosaemia Biotinidase deficiency

Abbreviations: PKU, phenylketonuria; HPA, benign hyperphenylalaninemia; BS, defects of biopterin cofactor biosynthesis; MSUD, maple syrup disease; HCY, homocystinuria (doe to cystathionine beta synthase deficiency); MAD, multiple acyl-CoA dehydrogenase deficiency; IBDH, isobutyryl-CoA dehydrogenase deficiency; MCAD, medium-chain acyl-CoA dehydrogenase deficiency; VLCAD, very long-chain acyl-CoA dehydrogenase deficiency; LCHAD, long-chain 3-hydroxy acyl-CoA dehydrogenase deficiency; mTFP, trifunctional protein deficiency; SCAD, short-chain acyl-CoA dehydrogenase deficiency; CPT-I, carnitine palmitoyltransferase I deficiency; CPT-II, carnitine palmitoyltransferase II deficiency; HMG-CoA lyase deficiency, 3-hydroxy 3-methyl glutaric aciduria

Analytical Methods

Acylcarnitines and amino acid (by Electrospray ionization-MS/MS). :
Analyzed as butyl esters on one of 3 Micromass triple quadrupole *tandem mass spectrometer* (Micromass / Waters, Eschborn, Germany) with an ion spray device (Schulze et al 2003). One 3-mm (1/8-inch) diameter dot was punched from each 10-mm diameter dried blood spot specimen into a single well of a 96-well microtiter filter plate to which was added 100 µl of a methanol stock solution of internal deuterated standards.

Endocrinological screening
TSH and 17-hydroxy-progesterone were determined by :
an automated *immunoassay system*
using the AutoDELFIA Neonatal hTSH Kit and Neonatal 17-hydroxy-progesterone Kit (Perkin Elmer Life Sciences, Rodgau-Jügesheim, Germany).

Galactosaemia screening
Screening for classical galactosaemia was performed by quantification of total galactose in blood followed by measurement of galactose-1-phosphate uridyltransferase (GALT) activity using the Quantas KIT provided by BioRad.

Biotinidase activity
was analysed using a *spectrophotometric method.*

Results

25.214 neonates were investigated for inborn errors of metabolism and endocrine disorders between December 2003 and July 2006.

The recall rate for all analysis was 1.8 %. (high rate of prematures with elevated 17-OHP)

	METABOLIC 19	ENDOCRINE 9	TOTAL 28
QATAR	1:1327	1: 2802	1:901
GERMANY	1:2901	1:2557	1:1728

*(Qatar N=25.214, Germany N=728.091**
** national screening report 2004 DGNS*
(German society for neonatal screening)

Statistics for Newborn Screening Program

Period: Dec 2003 - July 2006

N 25,214

Diagnosis	Total Recall	Total False +ve	Total confirm
Congenital Hypothyroidism	26	18	8
Congenital Adrenal Hyperplasia	156	155	1
Biotinidase	6	4	2
Phenyl ketunuria	16	15	1
Citrilinimia Type 1	1	0	1
Hyper phenylalanemia	1	0	1
MSUD	3	1	2
Homocystinuria	55	53	2
MCAD	8	2	6
Systemic Carnitine Def.	1	0	1
Methyl malonic aciduria	1	0	1
Cobalamine C/D Def.	1	0	1
3MCC	3	2	1

We knew that we have cases of

Homocystinuria ,
Sickle cell disease ,
and Congenital Hypothyroidism .

We did not know that we have

Medium-chain acyl-CoA dehydrogenase deficiency (MCAD) appears to be more frequent in Qatar than in Germany, a completely unexpected finding before installation of the screening program.

Homocystinuria

By clinical evaluation the incidence of classical homocystinuria was found to be individually higher than 1:3000, i.e. homocystinuria is the most prevalent metabolic disease in Qatar . (El-Said et al 2006).

Unfortunately, homocystinuria is poorly detected by current neonatal screening strategies using methionine as the primary indicator. From 25,214 samples "only" 2 patients could be detected.

A method for neonatal screening of homocystinuria was implemented from July 2006. It combines a rapid method to determine total homocysteine in dried blood spots by tandem-MS with the genetic testing for the prevalent mutations in parallel (El-Said et al 2006).

Sickle cell

As sickle cell disease has a high prevalence in other Middle East countries (Al-Riyami et al 2003) and as haematologists in Qatar suspect a high incidence in their patients …sickle cell disease will be soon added to the screening panel of Qatar.

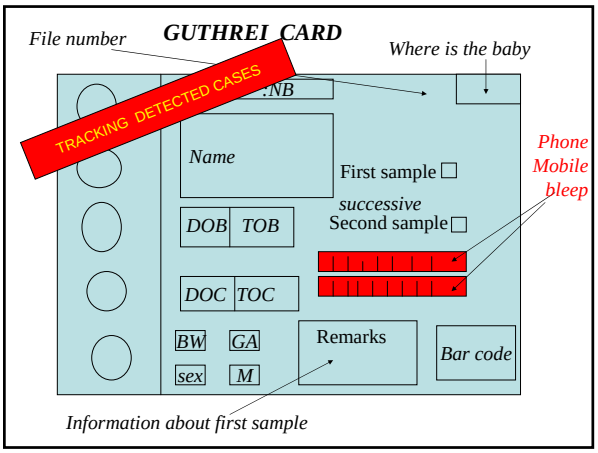
We did not face major barriers in developing the neonatal screening program.

What was needed was :

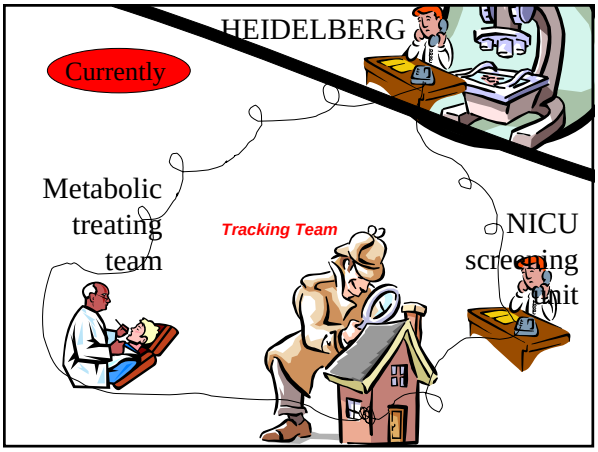
1) Health Authority acceptance and support.
2) ***A team well trained , committed and enthusiastic to implement the program.***
3) Well designed plan.
4) An Experienced Partner .

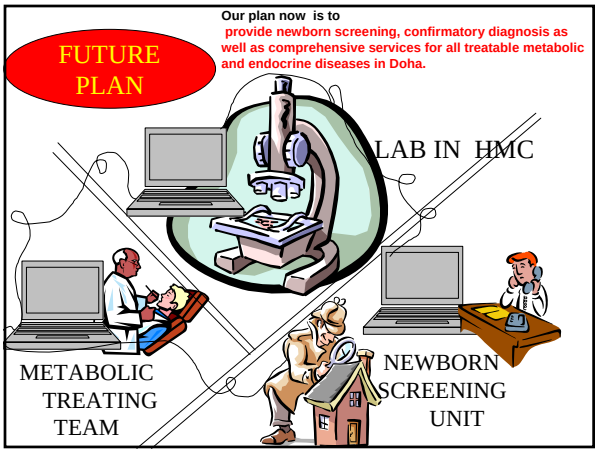
From our own experience :
Successful implementation of extended neonatal screening is possible even when laboratory facilities are not initially available in the respective country given that transportation and communication are optimised ……until all the facilities are available..

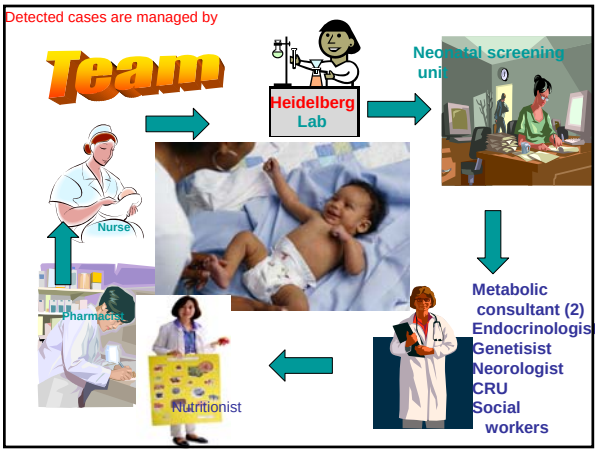
So…….We Do Not Have To Wait……



It was not difficult to track detected cases by using Modern transportation and communication tools.







Implementation of expanded neonatal screening and a metabolic unit in the State of Qatar: developing and optimising strategies in cooperation with the Neonatal Screening Center in Heidelberg

Martin Lindner1*, Ghassan Abdoh2, Junmin Fang-Hoffmann1, Noora Shabeck2, Muhammad Al Janahi2, Sirikit Ho1, M. O. Abdelrahman2, Muhammed Al Sayrafi2, Andreas Schulze1, Hilal Al Rifai2, Ghalia Al Thani2, Georg F. Hoffmann1

Depts. of Pediatrics, 1Ruprecht-Karls-University, Heidelberg, Germany, and 2Hamad Medical Corporation, Doha, Qatar

Journal of Inherited Metabolic Disease

JIMD