Rationale For Storing NBS Specimens

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Considerations and Recommendations for a National Policy Regarding the Retention and Use of Dried Blood Spot Specimens after Newborn Screening

Briefing ("White") Paper / September 2009

http://www.hrsa.gov/heritabledisorderscommittee/RBSBriefingPaperFINALDraft42310.pdf

The threat to the use of records and stored blood samples in medical screening research

NICHOLAS J WALD
MALCOLM LAW

Editorials
J Med Screen 2001

NEWBORN BLOOD COLLECTIONS:
Science Gold Mine, Ethical Minefield

Jennifer Couzin-Frankel

Science April 2009

Children and Population Biobanks

David Gurwitz, Isabel Fortier, Jeantine E. Lunshof, Bartha Maria Knoppers

Science, AUGUST 2009

> *“Access to samples and individual DNA sequence data from children included in population biobanks should, when feasible, await their consent as adults.”*

Are they useful?

What does Google say?

Dried blood spots:

0.17 seconds: 1,610,000 hits

Residual dried blood spots:

0.22 seconds: 223,000 hits

Analytes Measured in Dried Human Blood on Filter Paper ~ 1

Acarboxyprothrombin
Acylcarnitine
Adenine phosphoribosyl transferase
Adenosine deaminase
Albumin
α-fetoprotein
Amino Acids
  profiles
  arginine (Krebs cycle)
  histidine/urocanic acid
  homocysteine
  phenylalanine/tyrosine
  tryptophan
Andrenostenedione
Antipyrine
Arabinitol enantiomers
Arginase
Benzoylecgonine (cocaine)
Biotinidase
Biopterin
C-reactive protein
Carnitine
Carnosinase
CD4
Ceruloplasmin
Chenodeoxycholic acid
Chloroquine
Cholesterol
Cholinesterase
Conjugated 1-β hydroxycholic acid
Cortisol
Creatine kinase
Creatine kinase MM isoenzyme
Cyclosporin A
D-penicillamine
De-ethylchloroquine
Dehydroepiandrosterone sulfate
DNA (PCR)
acetylator polymorphism
alcohol dehydrogenase
α 1-antitrypsin
cystic fibrosis
Duchenne/Becker muscular dystrophy
glucose-6-phosphate dehydrogenase

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Analytes Measured in Dried Human Blood on Filter Paper ~ 2

hemoglobinopathies
- A,S,C,E
- D-Punjab
- beta-thalassemia
- hepatitis B virus
- HCMV
- HIV-1
- HTLV-1

Leber hereditory optic neuropathy
MCAD
mRNA
PKU
Plasmodium vivax
sexual differentiation
21-deoxycortisol
Desbutylhalofantrine
Dihydropteridine reductase
Diptheria/tetanus antitoxin
Erythrocyte arginase
Erythrocyte protoporphyrin
Esterase D
LSDs
Glutathione perioxidase
Glycocholic acid
Glycosylated hemoglobin
Halofantrine
Hemoglobin variants
Hexosaminidase A
Human erythrocyte carbonic anhydrase I
17-α hydroxyprogesterone
Hypoxanthine phosphoribosyl transferase
Immunoreactive trypsin (CF)
Lactate
Lead
Lipoproteins
- (a)
- B/A-1
- β

Lysozyme
Mefloquine
Netilmicin
Phenobarbitone

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Analytes Measured in Dried Human Blood on Filter Paper ~ 3

Purine nucleoside phosphorylase
Quinine
Reverse tri-iodothyronine (rT3)
Selenium
Serum pancreatic lipase
Sissomicin
Somatomedin C
Specific antibodies
- adenovirus
- anti-nuclear antibody
- anti-zeta antibody
- arbovirus
- Aujeszky's disease virus
- CD3
- CD45
- dengue virus
- Dracunculus medinensis
- Echinococcus granulosus
- Entamoeba histolytica
- enterovirus
- Giardia duodenalisa
- Helicobacter pylori
- hepatitus B virus
- herpes virus
- HIV-1
- IgE (atopic disease)
- influenza virus
- IRT 1
- IRT 2

Leishmania donovani leptospira
measles/mumps/rubella
Mycobacterium leprae
Mycoplasma pneumoniae
Onchocerca volvulus
parainfluenza virus
Plasmodium falciparum
poliovirus
Pseudomonas aeruginosa
respiratory syncytial virus
rickettsia (scrub typhus)
Schistosoma mansoni
Toxoplasma gondii
Trepenoma pallidium
Trypanosoma cruzi/rangeli
vesicular stomatis virus
Wuchereria bancrofti
yellow fever virus

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Analytes Measured in Dried Human Blood on Filter Paper ~ 4

Spectic antigens
- hepatitis B virus
- HIV-1
- HTLV-1
- H1N1
- p24, p72
- HLA-A, B, DR

Succinylacetone
Sulfadoxine
Theophylline
Thyrotropin (TSH)
Throxine (T4)
Thyroxine-binding globulin
Trace elements
Transferrin
UDP-galactose-4-epimerase
Leishmania donovani leptospira
measles/mumps/rubella
Mycobacterium leprae
Mycoplasma pneumoniae
Onchocerca volvulus
parainfluenza virus
Plasmodium falciparum
poliovirus
Pseudomonas aeruginosa
respiratory syncytial virus
rickettsia (scrub typhus)
Schistosoma mansoni
Toxoplasma gondii
Trepenoma pallidium
Trypanosoma cruzi/rangeli
vesicular stomatis virus
Wuchereria bancrofti
yellow fever virus
Succinylacetone
Sulfadoxine
Theophylline
Thyrotropin (TSH)
Throxine (T4)
Thyroxine-binding globulin
Trace elements
Transferrin
UDP-galactose-4-epimerase
Urea
Uroporphyrinogen I synthase
Vitamin A
White blood cells
Zinc protoporphyrin

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Analytes Measured in Dried Human Blood on Filter Paper

TOTAL: 162 published uses

Information courtesy of
Harry Hannon. CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

We know how to store and use them

Guidelines for the Retention, Storage, and Use of Residual Dried Blood Spot Samples after Newborn Screening Analysis: Statement of the Council of Regional Networks for Genetic Services

"Potentially these samples provide a genetic material "bank" for all newborns nationwide. Their value as a resource for other uses has already been recognized by scientists, administrators, and judicial officials."

BL Therell, WH Hannon, KA Pass, *et al.*
Biochem Mole Med 1996
32 references

Rationale for saving residual NBS specimens?

- unique
- unbiased population coverage
- nearly complete population coverage
- sometimes it is the only remaining tissue sample
- use for developing new assays
  - both positive specimens and controls
- Public Health studies
  - HIV seroprevalence
    - not available for NY retrospective study in 1987
  - Love Canal
    - first identification of PCB hazards

Rationale for saving residual NBS specimens? (2)

- reflect fetal exposures
  - alcohol
    - FAS
  - drugs
  - environment
    - Three Mile Island
    - perfluorinated compounds
    - cocaine, nicotine, caffeine
    - hepatitis B
    - toxoplasmosis, syphilis, rubella
    - birth defects and folate
    - pesticides
    - E. coli

Rationale for saving residual NBS specimens? (3)

- source of DNA
  - confirmation of biomarker assay
  - characterization of phenotype
  - forensics
  - allele frequency studies
  - proteinomics
  - metabolomics
    - increased specificity in
      - CF, CH, CAH, SSD, galactosemia
  - future studies unknown to us today (HIV, TMI)
- Retrospective studies, both biochemical and molecular

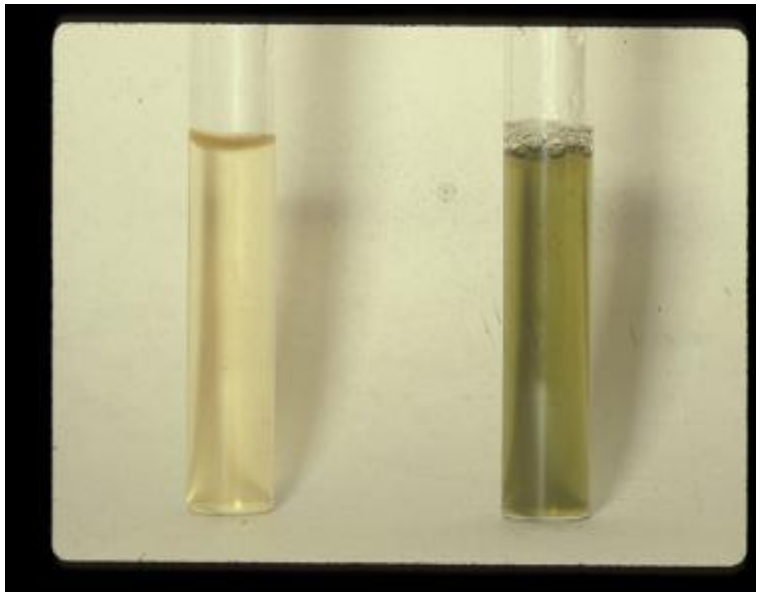
Rationale for saving residual NBS specimens? (4)

- unexpected uses
  - ghosts
  - mummified white cells
- discovery
  - autism
  - fragile X

Rationale for saving residual NBS specimens?

They are irreplaceable !

….and they sure beat daily wet diapers by the hundreds !!



Thank you.